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WESTERN NEW YORK RIVER BASINS

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# ERIE - NIAGARA BASIN

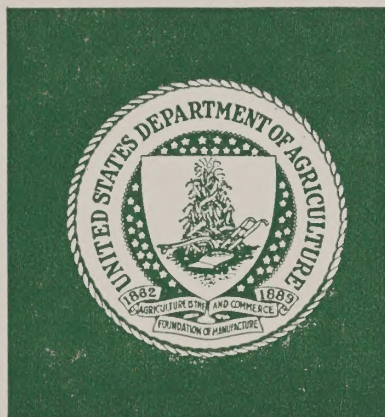


UNITED STATES DEPARTMENT OF AGRICULTURE  
ECONOMIC RESEARCH SERVICE  
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UNITED STATES DEPARTMENT OF AGRICULTURE REPORT  
FOR THE  
ERIE-NIAGARA RIVER BASIN

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WESTERN NEW YORK  
TYPE IV  
RIVER BASINS STUDY

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service   Economic Research Service   Forest Service

December 1970



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## SUMMARY

### OBJECTIVE AND SCOPE

The New York State Water Resources Planning Act (1959) enables the State Water Resources Commission to cooperate with and assist local governments in water resources planning studies. As a result of this Act, the Erie-Niagara Regional Water Resources Planning Board, composed of local leaders, was established in January 1963 at the request of the Boards of Supervisors of Erie, Genesee, Wyoming, and Cattaraugus Counties. The Board is responsible for the conduct of the study and the preparation of a comprehensive plan for the development, utilization, and control of the water resources of the Erie-Niagara Basin.

The Water Resources Commission has directed the Division of Water Resources, New York State Department of Environmental Conservation, to provide technical services for the Board. The Division also has the responsibility of coordinating the efforts of state and federal agencies participating in the study.

The Water Resources Commission requested the participation of the United States Department of Agriculture in studies of Western New York River Basins. The Erie-Niagara Basin is the first of such studies.

This report represents the United States Department of Agriculture's contribution of information for the formulation of a comprehensive plan for the water and related land resources of the Basin. This information was developed by the Economic Research Service, Forest Service, and Soil Conservation Service. It is also the responsibility of these and other cooperating agencies to assist the Erie-Niagara Board during the formulation of a comprehensive plan.

### SIZE AND LOCATION

The Erie-Niagara Basin is located in Western New York State and encompasses all of Erie County except Grand Island and portions of Allegany, Cattaraugus, Chautauqua, Genesee, Niagara, Orleans, and Wyoming Counties. There are 1,266,000 acres (1,975 square miles) of land in the Basin. This represents approximately four percent of the total state area. All water courses are tributary to Lake Erie and the Niagara River.

The present population is approximately 1.2 million and is expected to increase to 2.1 million by 2020. The state's second largest city, Buffalo, is the major industrial and business center in the Basin. The Buffalo and Niagara Falls area is one of the top 14 manufacturing centers in the United States. Agriculture generates a significant share of the income and over 70 percent of the total land area in the Erie-Niagara Basin is agricultural land. Figure 1.1 includes a map showing major land uses.

## PROBLEMS AND NEEDS

The United States Department of Agriculture presents, in this report, descriptions of the agricultural and forest problems and needs within the Basin which could be satisfied through USDA programs. Task studies were made by watersheds as delineated in the New York State Soil and Water Conservation Needs Inventory. Watershed locations and names are shown in Figure 1.1.

Figure 1.2 shows the location of (1) floodwater damages totaling approximately 1.5 million dollars per year, (2) over 135 miles of polluted streams, and (3) seven locations which have water supply systems that are inadequate or not fully developed. These problems were identified by New York State agencies, the U. S. Army Corps of Engineers and the Soil Conservation Service.

Figure 1.2 shows the floodwater problems studied by the United States Department of Agriculture. These areas flooded total over 22,400 acres with damages averaging \$102,700 annually. Studies were made to determine if a USDA or other program might provide flood damage reduction through structural or non-structural measures. Other federal and state agencies were responsible for the problems within or near urban areas such as Buffalo and Batavia.

Soil erosion, excess water, and shallow and droughty soil conditions are on more than 30 percent, or about 414,000 acres, of the total Basin area. All forest land must be protected from forest fires. Approximately 80 miles of eroding streambanks in the Basin and from 100 to 1,500 tons of sheet erosion per square mile contribute to the sediment problem.

Available cropland is expected to decrease from a present 439,700 acres to 204,500 acres by the year 2020. To improve crop yields of uniform quality, irrigation of cropland is expected to expand from the present 4,700 acres irrigated to nearly 45,000 acres by 2020. Most vegetables, potatoes, and small fruits are expected to be irrigated. Figure 1.3 shows the irrigable land areas where irrigation could take place.

Inadequate drainage is a problem on 91,000 acres of cropland. Figure 1.3 depicts the areas which require various types of drainage.

FIGURE 1.1 CHARACTERISTICS OF ERIE-NIAGARA BASIN AND WATERSHED LOCATIONS

# THE ERIE NIAGARA BASIN

SIZE - 1975 SQUARE MILES

LOCATION - WESTERN NEW YORK STATE

COUNTIES INCLUDED:

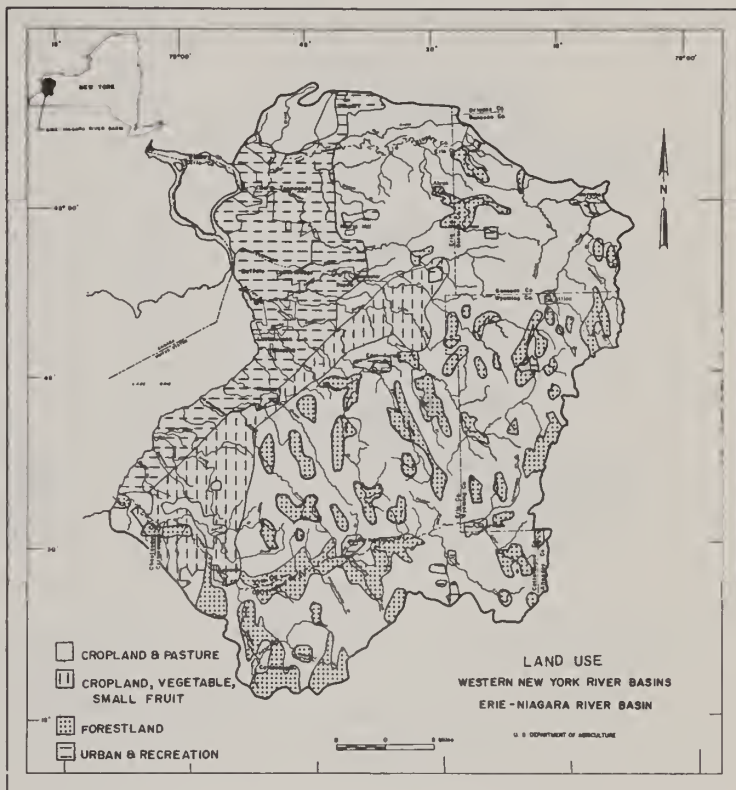
ALLEGANY	GENESEE
CATTARAUGUS	NIAGARA
CHAUTAUQUA	ORLEANS
ERIE	WYOMING

POPULATION - 1.2 MILLION IN 1967  
(2.1 MILLION EXPECTED IN 2020)

WATER COURSES - ALL TRIBUTARY TO LAKE ERIE  
AND NIAGARA RIVER

LAND USE -

CROPLAND	425,800 ACRES	-	34%
PASTURE	166,700 ACRES	-	13%
FOREST	306,400 ACRES	-	24%
URBAN	101,600 ACRES	-	8%
OTHER LAND	<u>265,500 ACRES</u>	-	<u>21%</u>
TOTAL	1,266,000 ACRES	-	100%



## WATERSHEDS

PROBLEMS, NEEDS, AND POTENTIAL SOLUTIONS  
WERE STUDIED AND IDENTIFIED BY THE FOLLOWING  
WATERSHEDS:

<u>WATERSHED NO.</u>	<u>NAME</u>
1	BUFFALO CREEK
44	CATTARAUGUS CREEK
56	EIGHTEENMILE CREEK
57	ELLICOTT CREEK
72	BIG AND LITTLE SISTER CREEKS
115	SMOKES CREEK
148	UPPER TONAWANDA CREEK
203	WANAKAH - LAKE ERIE
238	MIDDLE TONAWANDA CREEK
239	LOWER TONAWANDA CREEK
240	MURDER CREEK
241	RANSOM CREEK
244	SCAJAQUADA CREEK
245	MUD CREEK

FIGURE 1.2 PROBLEMS AND NEEDS - FLOODWATER, POLLUTION, WATER SUPPLY AND LAND TREATMENT

### PROBLEMS AND NEEDS

FLOODWATER - 54,000 ACRES FLOODED

\$1,000,000 DAMAGE YEARLY

NEEDS - FLOOD PLAIN ZONING, CHANNEL  
IMPROVEMENT, RESERVOIRS

STREAM POLLUTION - OVER 135 MILES OF POLLUTED STREAMS

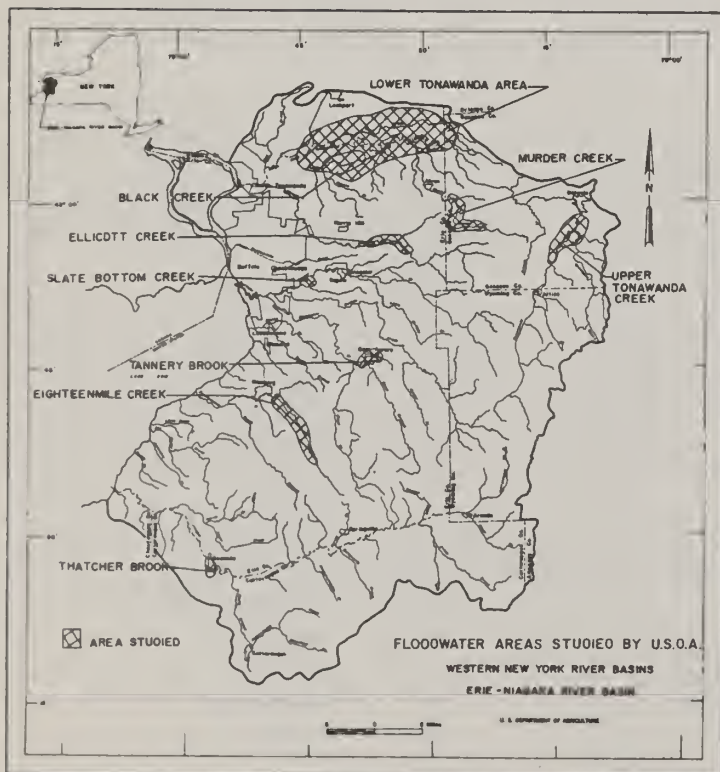
NEEDS - IMPROVED TREATMENT FACILITIES  
LOW FLOW AUGMENTATION

WATER SUPPLY - SEVEN LOCATIONS WITH INADEQUATE SUPPLY

NEEDS - EXPANDED SERVICES FROM LAKE ERIE  
GROUND WATER AND UPSTREAM RESERVOIRS

LAND - 414,000 ACRES NEED PROPER TREATMENT TO REDUCE  
EROSION, SEDIMENTATION, EXCESS WATER, FOREST  
MANAGEMENT AND PROTECTION

80 MILES OF ERODING STREAMBANK NEEDS STABILIZATION



### FLOODWATER PROBLEMS STUDIED BY USDA

WHERE - LOCATED WITHIN THE AGRICULTURAL  
COMMUNITY AND WHICH MIGHT BE  
APPLICABLE TO A USDA PROGRAM

HOW MUCH - WITH AREAS FLOODED TOTALING OVER  
25,000 ACRES WITH DAMAGES AVERAGING  
\$84,200 YEARLY

WHY - TO DETERMINE IF A USDA OR OTHER PROGRAM  
MIGHT PROVIDE FLOOD DAMAGE REDUCTION

HOW - THROUGH STRUCTURAL OR NONSTRUCTURAL  
MEASURES

## IRRIGATION

IRRIGATION WILL BE NEEDED IN THE FUTURE TO INCREASE AND STABILIZE CROP QUALITY AND YIELDS ON THE EVER-DECREASING AMOUNT OF AVAILABLE CROPLAND.

IRRIGABLE LAND AREA - 136,000 ACRES

LAND PRESENTLY IRRIGATED - 4,700 ACRES

LAND EXPECTED TO BE IRRIGATED BY YEAR 2020 - 45,000 ACRES

CROPS TO BE IRRIGATED - VEGETABLES, POTATOES AND SMALL FRUITS

FUTURE WATER SUPPLY SOURCES - GROUND WATER, STREAM, LAKES, AND UPSTREAM RESERVOIR DEVELOPMENTS



## AGRICULTURAL DRAINAGE NEEDS

## GROUP ACTION AND ON-FARM -

THE ENLARGEMENT OF MAJOR STREAMS AND MAIN OUTLET DITCHES BEFORE ON-FARM DRAINAGE CAN BE EFFECTIVE.

## SMALL GROUP ACTION AND ON-FARM -

THE ENLARGEMENT OF TRIBUTARIES, DITCHES, OR TILE SYSTEMS WHICH PROVIDE OUTLETS TO INDIVIDUALS AND SMALL GROUPS OF LANDOWNERS BEFORE ON-FARM DRAINAGE CAN BE EFFECTIVE.

## ON-FARM -

THE INSTALLATION OF OPEN DITCH AND TILE SYSTEMS WHERE ADEQUATE OUTLET CHANNELS ARE NOW AVAILABLE TO EACH LANDOWNER.

An increasing demand for recreation and fish and wildlife facilities is created by the major population centers of Buffalo and Niagara Falls. The two-fold increase in population expected by 2020 will bring great pressures on present recreation facilities and available forest land.

All problems and needs stated above demand careful development and proper management of the Basin's water and related land resources. There are obvious needs for measures such as flood plain regulation; channel improvements; upstream reservoir sites; ground water, lake, and stream development; improved waste treatment facilities; streambank stabilization; and land treatment.

## FINDINGS AND CONCLUSIONS

### SOLUTIONS THROUGH USDA PROGRAMS

Figure 1.4 shows 14 recommended project developments applicable under USDA programs which could be initiated and developed in the near future to help meet the ever-increasing demands upon water and related land resources. Project developments applicable under Public Law 566 and the Resource Conservation and Development Program, would require about 92 miles of channel improvement for flood control and drainage and 19 upstream reservoir sites for such purposes as irrigation, recreation, flood control, fish and wildlife, and low flow augmentation. The total estimated cost for all these projects is \$13,301,400. Of this total, \$5,102,800 would be federal cost and \$8,198,600 nonfederal cost.

#### PUBLIC LAW 566 PROJECTS

Nine projects are applicable under PL-566. The total estimated cost of these projects is \$10,062,000 of which \$4,640,800 could be borne by federal funds and \$5,421,200 by nonfederal funds.

The structural measures for these PL-566 projects would involve approximately 92 miles of channel improvement and 19 upstream reservoir sites.

Seven projects are primarily for irrigation water supply with an excellent potential for supplying low flow augmentation in three of these and some flood damage reduction in one project on Thatcher Brook.

The Tannery Brook project would provide flood protection to the village of East Aurora. Another project development of area size is Lower Tonawanda Creek which would provide flood control and drainage for agricultural lands (see Figure 1.5).

It should be recognized that present federal policies are favorable only to projects having flood control as the primary purpose. Therefore, Tannery Brook would be the one good possibility for PL-566 approval at the present time since it is a flood prevention project.

FIGURE 1.4 EARLY ACTION AND FUTURE POTENTIAL

# POTENTIAL DEVELOPMENTS UNDER USDA PROGRAMS

STRUCTURAL MEASURES - 92 MILES OF CHANNEL IMPROVEMENT  
19 UPSTREAM RESERVOIR SITES

PROGRAM	ESTIMATED COST \$		TOTAL
	FEDERAL	NONFEDERAL	
9 PUBLIC LAW 566 PROJECTS	4,640,800	5,421,200	10,062,000
5 RESOURCE CONSERVATION AND DEVELOPMENT PROJECTS	462,000	2,777,400	3,239,400
TOTALS	5,102,800	8,198,600	13,301,400

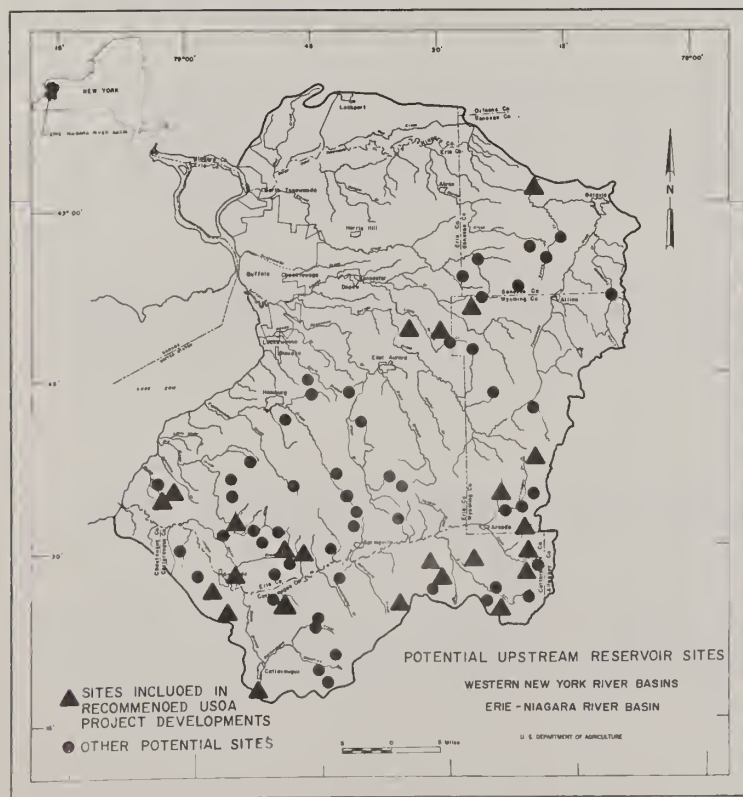
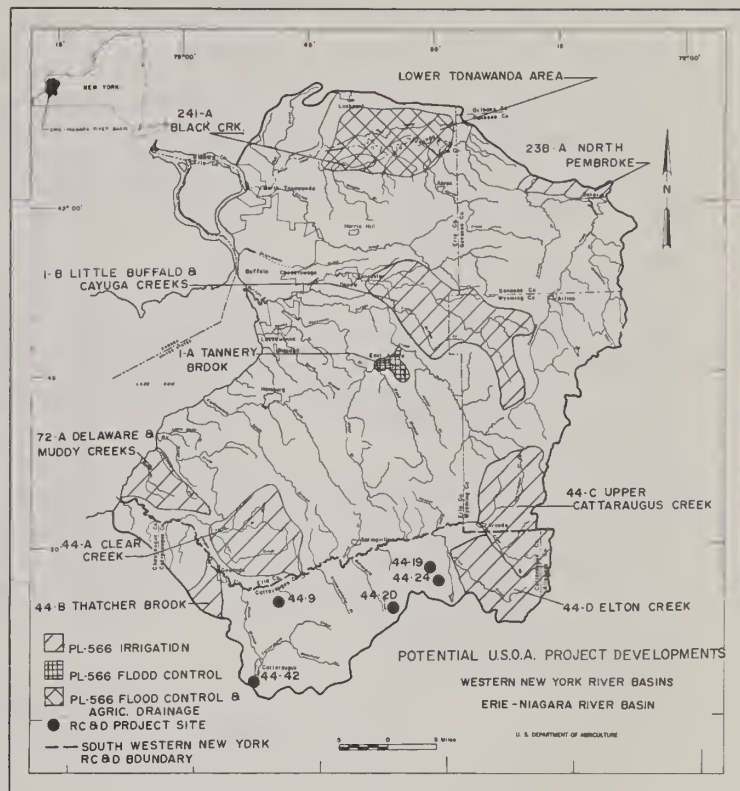
LAND TREATMENT MEASURES - NEEDED ON 92,500 ACRES BY 1980

ESTIMATED COST \$		
FEDERAL	NONFEDERAL	TOTAL
2,730,000	3,648,600	6,378,600

## PROJECT PURPOSES -

IRRIGATION  
FLOOD CONTROL  
DRAINAGE

LOW FLOW AUGMENTATION  
RECREATION  
FISH AND WILDLIFE



## POTENTIAL UPSTREAM RESERVOIR SITES

### EARLY ACTION -

19 UPSTREAM PL-566 AND 5 RC&D RESERVOIR SITES  
RECOMMENDED FOR THE NEAR FUTURE USDA DEVELOPMENTS

### WOULD SUPPLY -

IRRIGATION WATER - 6,440 ACRE-Feet  
RECREATION AND/OR  
FISH AND WILDLIFE - 1,200 SURFACE-ACRES  
LOW FLOW AUGMENTATION - 7,800 ACRE-Feet

### FUTURE POTENTIAL -

THE REMAINING 59 UPSTREAM RESERVOIR SITES SHOULD  
BE CONSIDERED IN SATISFYING NEEDS BEYOND THE  
NEAR FUTURE.

### POTENTIAL PURPOSES -

IRRIGATION  
FLOOD CONTROL  
RECREATION

MUNICIPAL AND INDUSTRIAL  
WATER SUPPLY  
LOW FLOW AUGMENTATION  
FISH AND WILDLIFE

FIGURE 1.5 LOWER TONAWANDA AREA DEVELOPMENT POTENTIAL

### LOWER TONAWANDA AREA

HAS EXCELLENT POTENTIAL FOR AGRICULTURAL DEVELOPMENT BECAUSE:

MOST OF THE SOILS WOULD BE HIGHLY PRODUCTIVE UNDER PROPER TREATMENT AND MANAGEMENT

HAS CLOSE PROXIMITY TO BUFFALO MARKET

FLOODING, AND DRAINAGE CONDITIONS ARE HAZARDOUS TO URBAN DEVELOPMENT

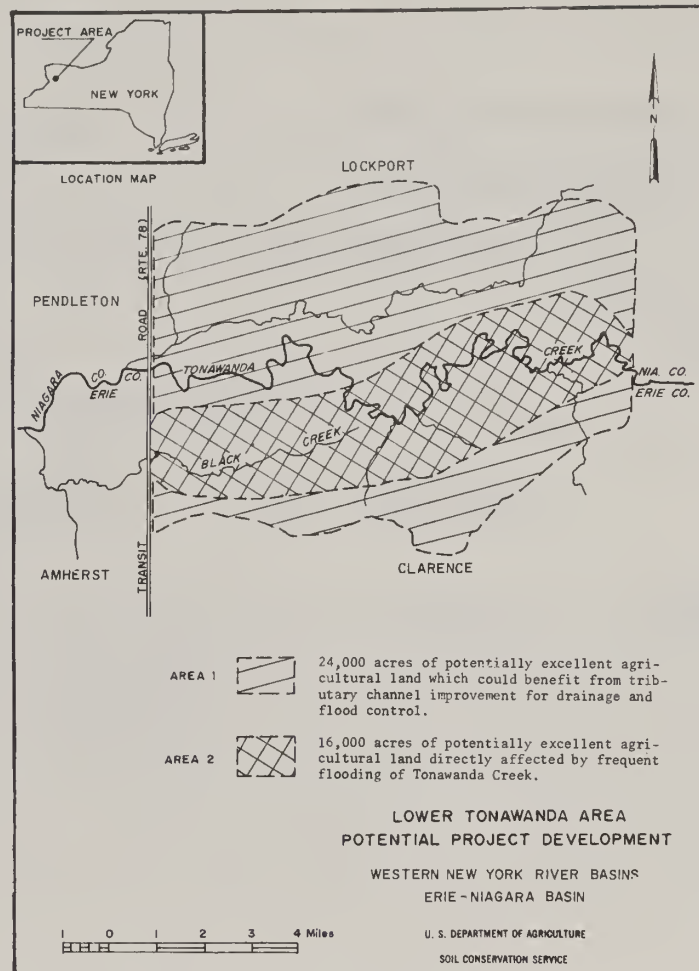
FLOOD AND DRAINAGE IMPROVEMENT CAN BE ECONOMICALLY PROVIDED FOR AGRICULTURAL USE, BUT NOT FOR URBAN USE.

DEVELOPMENT SHOULD BE ACCOMPLISHED IN THE FOLLOWING STAGES:

ZONE THE 40,000 ACRE AREA FOR OPEN SPACE AND CONSERVATION USES

DEVELOP CHANNEL IMPROVEMENT PROJECTS IN AREA 1

DEVELOP CHANNEL IMPROVEMENT PROJECTS IN AREA 2, AFTER A CORPS OF ENGINEERS PROJECT REDUCES FLOOD FREQUENCY ON TONAWANDA CREEK



## RESOURCE CONSERVATION AND DEVELOPMENT PROGRAM

Five single purpose recreation sites could be developed within the Seneca Trails Resource Conservation and Development Project Area. These single site project developments would cost an estimated \$3,239,400 and furnish about 400 water surface acres. Federal funds could provide about \$462,000 in technical assistance and \$2,774,400 would be borne by local funds.

## LAND TREATMENT PROGRAMS

Land treatment needs to be applied to 92,500 acres by the year 1980. The total estimated cost is \$6,378,600. Federal cost would amount to \$2,730,000 and \$3,648,600 borne by individual landowners and operators.

Proper treatment of the Basin's land is important to control erosion, reduce sediment, maintain water quality, and achieve proper land use and management. Land treatment upstream from reservoir sites is especially important to control soil erosion. The resulting sediment accumulation reduces reservoir storage capability and the quality of its water.

## DEVELOPMENT POTENTIAL OF WATER AND RELATED LAND RESOURCES

The lower half of Figure 1.4 shows the location of 50 potential upstream reservoir sites which should be considered in satisfying needs beyond the near future. The design and cost data for these sites can be found in the publication "Upstream Reservoir Studies". Copies of this document are located in the Soil Conservation Service offices in each soil and water conservation district in the Basin. The New York State Department of Environmental Conservation, Division of Water Resources, also have copies in their offices.

The Tonawanda Creek flood protection project, now being studied by the U. S. Army Corps of Engineers, is needed to realize the full potential of the Lower Tonawanda Creek area. Site 148-6 (Linden) could be included in this project for multi-purpose uses including irrigation within and outside of the Basin.

USDA flood damage appraisals indicate that only nonstructural measures are feasible on many streams. Flood plain regulation is needed on Tonawanda Creek, Murder Creek, Ellicott Creek, Slate Bottom Creek, and Eighteenmile Creek.

## IMPACTS OF POTENTIAL PROJECTS AND PROGRAMS

The installation of the project measures recommended for the near future would have significant physical and economic effects. The projects would

supply irrigation water for 6,400 acres, decrease flooding and improve drainage on about 40,000 acres, provide about 1,200 surface acres of water for 700,000 annual visitor days of recreation, and supply 7,600 acre-feet for low flow augmentation.

An estimated \$1.7 million would be provided to national efficiency objectives. The regional effects are estimated at almost \$3.3 million annually with an additional estimated \$25 million during project installation expenditures.

#### ADDITIONAL AUTHORIZATION

Authorities under existing federal, state and local laws are not completely adequate to implement the upstream aspects of a comprehensive plan to meet near future needs. Programs available through the United States Department of Agriculture will provide technical and cost-sharing assistance for measures which primarily involve flood control, irrigation, drainage, and land treatment. However, in order to facilitate the portions of the programs dealing with single and multipurpose recreation, fish and wildlife, municipal and industrial water supply and water quality control, additional authorization will be required.

The recommended authorization would enable the Secretary of Agriculture to provide federal technical and cost-sharing assistance for these other purposes the same as that contained in other existing authorities. A sample statement recommending additional authorization is contained in Chapter 9 of this report.

# INTRODUCTION

Projections of increases in population, industrial output, and agricultural water use point to increased pressures on our water resources and possible conflicts among users competing for limited supplies. To minimize those conflicts, it is highly desirable that a cooperative and coordinated effort be made to identify potential problem areas and evaluate means of resolving them.

The United States Department of Agriculture assisted in the preparation of a comprehensive and coordinated plan for the development of the water and related land resources of the Erie-Niagara Basin under the authority of Section 6, Public Law 566, 83rd Congress, as amended.

This study was in cooperation with the Erie-Niagara Basin Regional Water Resources Planning Board, a legal entity of New York State, authorized to obtain assistance from various federal, state, and local agencies. Federal participation, in addition to the U.S. Department of Agriculture, included the U.S. Army Corps of Engineers, the Departments of Interior and Commerce, and the Federal Power Commission. New York State agencies participating were the Department of Agriculture and Markets, Commerce, Environmental Conservation, Health, Law, Transportation, and Office of Local Government.

The New York State Water Resources Planning Act (1959) enables the State Water Resources Commission to cooperate with and assist local governments in water resources planning studies. Since July 1, 1970, the Water Resources Commission has been dissolved and its duties and functions have been taken over by the Department of Environmental Conservation. The Boards of Supervisors of Erie, Genesee, Wyoming and Cattaraugus counties applied for a study within the area shown on Figure 2.1, and the first Regional Water Resources Planning Board within the State was established in January 1963. It is known as the Erie-Niagara Regional Water Resource Planning Board and is composed of local leaders representing various water resource interests.

The Board is responsible for the conduct of the study and the preparation of a comprehensive plan for the development, utilization, and control of the water resources of the Basin. Upon approval by the State Department of Environmental Conservation, the plan that is finally evolved will become the official plan controlling all water and associated land resources activities and developments in the region.

Enabling legislation provides that the State shall pay 75 percent and the petitioning counties 25 percent of the cost of the study.

The Division of Water Resources of the Department of Environmental Conservation has been assigned the responsibility of providing technical services and coordinating the overall study for the Board. Also, it requested through proper legislative action that the U.S. Department of Agriculture be appropriated federal funds to participate in Western New York River Basin studies. The Erie-Niagara Basin is the first of such studies.

This report represents the U.S. Department of Agriculture's contribution of information for the formulation of a comprehensive plan for the water and related land resources of the Erie-Niagara Basin. This information identifies water and related land resource problems and needs and recommends means for solving the problems and meeting needs.

The Economic Research Service, Forest Service, and Soil Conservation Service represent the U.S. Department of Agriculture in this study. Other federal, state, and local interests are providing reports on other needs and recommendations which will contribute to the formulation of a comprehensive water and related land resource plan for the Basin. The Board is basing its plan upon the projected needs, indicated problems, and recommendations for development described in these reports.

## OBJECTIVES

The primary objective of the U.S. Department of Agriculture's participation in the Erie-Niagara Basin is to facilitate the coordination and orderly conservation, development, utilization and management of water and related land resources. Toward this end, the departmental agencies made an inventory of the water and related land resources to the extent that it did:

1. Identify agricultural and rural water needs.
2. Identify upstream floodwater damages by major watershed areas. The floodwater inventory includes the delineation of major flood plain areas.
3. Identify upstream sediment and erosion problems.
4. In consideration of problems and needs, determine the potential for developing upstream reservoir sites.
5. Identify areas requiring improved land management and accelerated land treatment needs.
6. Define the potential for providing drainage to those areas which are presently excluded from an intensified agricultural program due to drainage problems.
7. Define the areas capable of being irrigated in terms of acres and quantities of supplemental water needs.
8. Define the economic development potential for agriculture.
9. Determine the opportunities for meeting basin-wide needs for water and related goods and services through potential water and related land resource developments in the upstream area.
10. Identify those upstream watershed projects which could be initiated in the next 10 to 15 years.

11. Consider the nonagricultural water needs defined by other agencies which can be met through upstream watershed development.

The results of these studies will provide for the formulation of short and long range water and related land resource programs for the Basin.

## LOCATION

The Erie-Niagara Basin is located in Western New York State and encompasses all of Erie County, except Grand Island and portions of Allegany, Cattaraugus, Chautauqua, Genesee, Niagara, Orleans, and Wyoming counties.

(Figure 2.1) Acreage by counties is:

<u>County</u>	<u>Acres</u>	<u>Percent of Total</u>
Allegany	3,200	<u>1/</u>
Cattaraugus	205,500	16
Chautauqua	8,000	<u>1/</u>
Erie	652,800	52
Genesee	139,300	11
Niagara	71,500	6
Orleans	600	<u>1/</u>
Wyoming	<u>185,100</u>	<u>15</u>
TOTAL	1,266,000	100

The data shows that 83 percent of the Basin is in three counties: Cattaraugus, Erie and Wyoming.

There are 1,266,000 acres (1,975 square miles) of land in the Basin. This represents approximately four percent of the total state area. The present population is approximately 1.2 million people.

## DESCRIPTION OF THE BASIN

The major industrial and business center in the Basin is Buffalo, the state's second largest city. The Niagara Falls industrial and recreational complex lies immediately to the northwest. The two cities constitute the business and industrial core for the so-called Buffalo Standard Metropolitan Statistical Area (SMSA), comprising Erie and Niagara counties.

The SMSA is one of the top 14 manufacturing centers in the United States. An abundant water supply for industrial and domestic use, excellent transportation, and a pool of skilled labor have been the underlying factors in the development of the area economy. Primary metals, transportation equipment, chemicals, and grain products comprise the principal products manufactured on the Niagara Frontier. Although the area is noted for its heavy

1/ Less than one percent

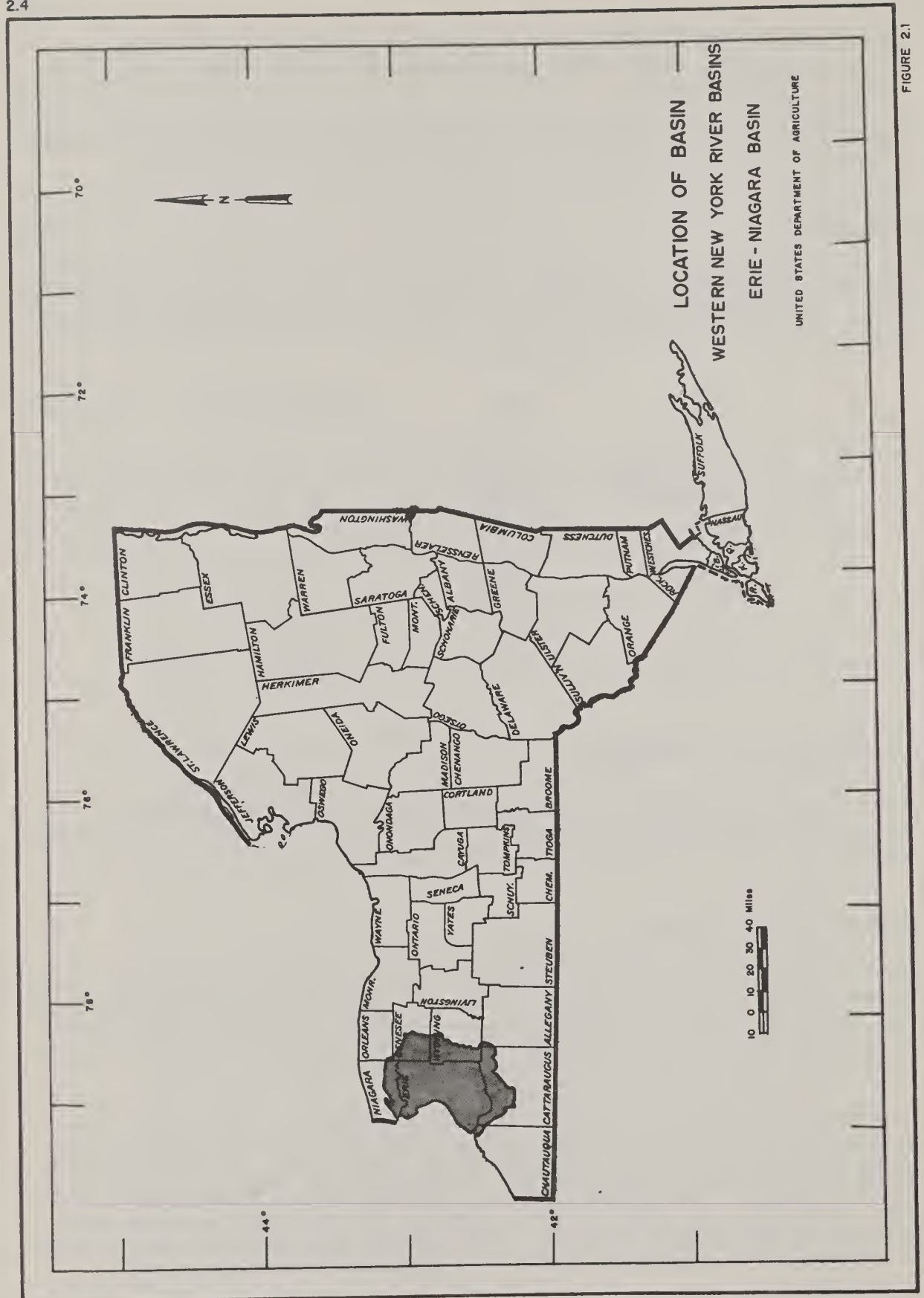


FIGURE 2.1

industry, agriculture generates a significant share of the income in the two counties, with dairy products, fruit, and fresh vegetables making up the principal farm products.

Agriculture also dominates the land use with cropland and pasture making up 47 percent and forest land an additional 24 percent of the total area. Urban lands total 8 percent.

## PROCEDURES

The natural subdivision of any river basin is by hydrologic watershed boundaries. It was agreed to use the New York State Soil and Water Conservation Needs Inventory delineations of watersheds (less than 250,000 acre drainage areas) for the study of the Erie-Niagara Basin. Locations of the watersheds are shown on Figure 2.2. Watershed numbers and names are:

<u>Watershed No.</u>	<u>Name</u>
1	Buffalo Creek
44	Cattaraugus Creek
56	Eighteenmile Creek
57	Ellicott Creek
72	Big and Little Sister Creeks
115	Smoke Creek
148	Upper Tonawanda Creek
203	Wanakah - Lake Erie
238	Middle Tonawanda Creek
239	Lower Tonawanda Creek
240	Murder Creek
241	Ransom Creek
244	Scajaquada Creek
245	Mud Creek

Using the watershed as a base, the study was conducted in two phases. In the first phase, an economic base study considering the agricultural resources of the area was made. Floodwater problems of both an agricultural and nonagricultural nature were inventoried for each major stream and its tributaries. Sediment and erosion problems were investigated. Problems and needs were identified during this phase and those areas worthy of more intensive investigation were determined.

The second phase investigations were in greater detail. Areas of soils suited to irrigation were delineated and acreages were computed. An inventory of potential sites for upstream water impoundments was made. These upstream sites were screened as potential sources of irrigation water supply in relation to the availability of irrigable soil downstream and for other multiple-purpose uses. The more promising sites were selected and further evaluated.



The inventory, data, and analyses developed in this study provided an opportunity for identifying possible future PL-566 small watershed projects. It is hoped that this study will be used by other federal, state, and local agencies in planning and developing the water and related land resources in this Basin.



## NATURAL RESOURCES OF THE BASIN

### PHYSIOGRAPHY AND GEOLOGY

The Erie-Niagara Basin is in two physiographic regions. The northwestern or upper half is in the Ontario Plain which has nearly level to moderately sloping rolling landforms. Dividing the plain into two levels is the Onondaga escarpment. The southeastern or lower half is in the Allegheny Plateau. Broad, gentle to moderate sloping, rolling, hilltop landforms of the plateau are dissected by narrow, incised, steep-sided valleys. Most of the streams in the valleys flow in a north or northwesterly direction except for the westerly flowing Cattaraugus Creek. These physiographic regions correspond to the Land Resource Areas in the Basin.

Minimum elevation is approximately 570 feet mean sea level on the Niagara River at the mouth of Tonawanda Creek. The highest elevation, Watson Hill 2,288 feet, is located west of Ellicottville at the southern boundary in Cattaraugus County.

Bedrock on the Ontario Plain is dominantly shale and limestone. Onondaga limestone is exposed on the face of the Onondaga escarpment. Bedrock of the plateau area is interbedded shale and sandstone. At the edges of the plateau and on the steep sides of the dissected valleys, the bedrock is usually within two feet of the surface.

Lake-laid soils are dominant on the Ontario Plain. Most of the soils are heavy and have restricted drainage. Glacial till soils, dominant on the plateau, are generally not as heavy, but a compact subsoil restricts drainage. For more detailed information on soils, refer to the publication, *A Report on the General Soils Areas of the Erie-Niagara Basin* which contains a soil association map.

Mineral resources include sand and gravel, limestone, gypsum, shale for bricks and clay products, and natural gas.

### LAND RESOURCES

Land resource areas are broad areas of land having similar patterns of soils, climate, agriculture, native vegetation, water resources, topography, and land use. According to the *Land Resource Regions and Major Land Resource Areas of the United States*, there are three resource areas in the Erie-Niagara Basin (Figure 3.1). LRA L-100 covers the southwestern part of the Basin and is known as the Erie-Huron Lake Plain of the Lake States Fruit, Truck, and Dairy Region. Farm acreage is mainly in canning and truck crops, and fruit. In the same LRA region is L-101, the Ontario-Mohawk Plain, which covers the northern part of the Basin. The area is characterized by level to gently rolling topography and is well suited to agricultural production. Here the largest farm acreage is in feed and forage crops in support of dairying.

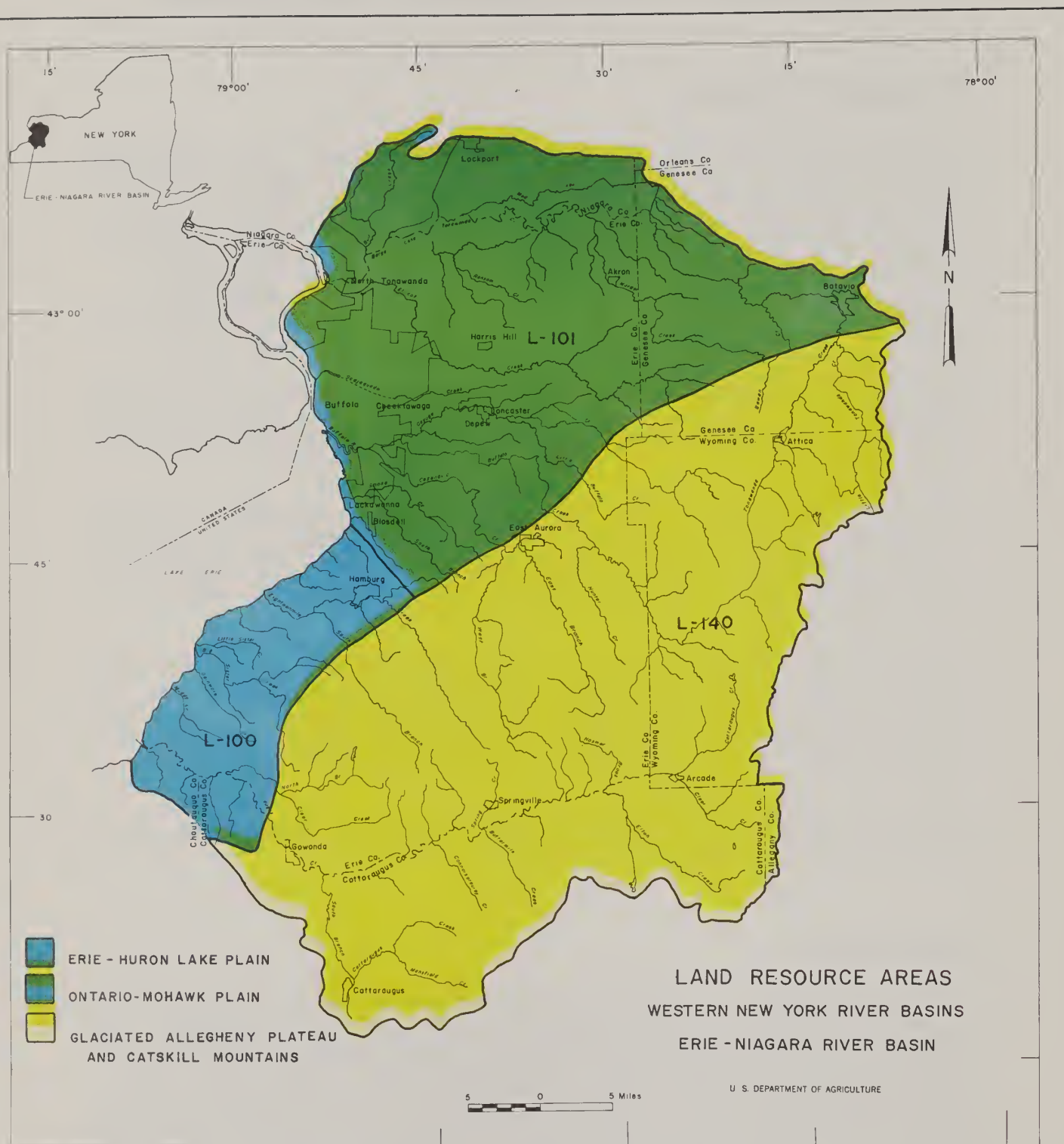


FIGURE 3.1

The southern half of the Basin is R-140, the Glaciated Allegheny Plateau and Catskill Mountains of the Northeastern Forage and Forest Region. There are large areas of forest land composed of cut-over mixed hardwoods, particularly in the headwater areas and along steep slopes of the plateau boundary. Hay, pasture, and grain in support of dairying are the principal crops.



TYPICAL ALLEGHENY PLATEAU DAIRY FARM

Most of the land area is in agriculture and forests as shown on the land use map (Figure 3.2). The distribution of the major land uses in each county is given in Table 3.1.



Table 3.1. Present Land Use Estimates, 1968<sup>1/</sup>

County	Crop (Acres)	Pasture (Acres)	Forest (Acres)	Other (Acres)	Urban (Acres)	Total (Acres)	Percent
Allegany	900	300	1,900	100	-	3,200	2/
Cattaraugus	63,800	51,800	77,600	11,000	1,300	205,500	16
Chautauqua	2,400	2,800	2,400	400	-	8,000	2/
Erie	157,000	38,000	148,000	218,500	91,300	652,800	52
Genesee	82,200	18,400	21,200	14,200	3,300	139,300	11
Niagara	46,000	3,900	4,300	13,600	3,700	71,500	6
Orleans	100	-	-	500	-	600	2/
Wyoming	73,400	51,500	51,000	7,200	2,000	185,100	15
TOTAL	425,800	166,700	306,400	265,500	101,600	1,266,000	
PERCENT OF TOTAL	34	13	24	21	8	100	

<sup>1/</sup> Adapted from the Conservation Needs Inventory, Forest Survey, and the Area Measurements Report.

<sup>2/</sup> Less than 1%.

## CLIMATE

Climatically this is a very heterogeneous area. Variation in topography results in variations in precipitation, temperature, and growing season. Lake Erie has considerable effect on the Basin climate.

### PRECIPITATION

Precipitation is generally well distributed throughout the year and falls as rain, snow, sleet and hail. The mean annual precipitation ranges from about 30 inches in the northern portion of the Basin to 40 inches in the south. Annual extremes in precipitation for the lowest and highest years of record in the northern part of the Basin at the Buffalo Airport were 22 inches and 45 inches. Further south at the Gowanda State Hospital, the lowest figure recorded was 29 inches and the highest was 47 inches. Average monthly rainfall on the Ontario Plain is higher during more months of the year than on the Allegheny Plateau. This situation is reversed in May, June, July and August when rainfall is greatest on the plateau area. (Figure 3.3)

Precipitation related problems such as droughts, thunderstorms, and snow and ice storms occur throughout the Basin. Climatological data for the Buffalo station, indicates that excessively wet springs have occurred occasionally and that summer droughts have occurred on an average of once in five years. Thunderstorm frequency in the Buffalo area average 30 per year with most occurring in June, July, and August. Buffalo has an average annual snowfall of about 97 inches while the amount of snowfall and frequency of storms are even greater south of Buffalo.

### TEMPERATURE

The mean annual temperature in the Basin is about 49 degrees. The lowest average monthly temperatures occur in February, and the highest in July for both the Ontario Plain and Allegheny Plateau areas. (Figure 3.4)

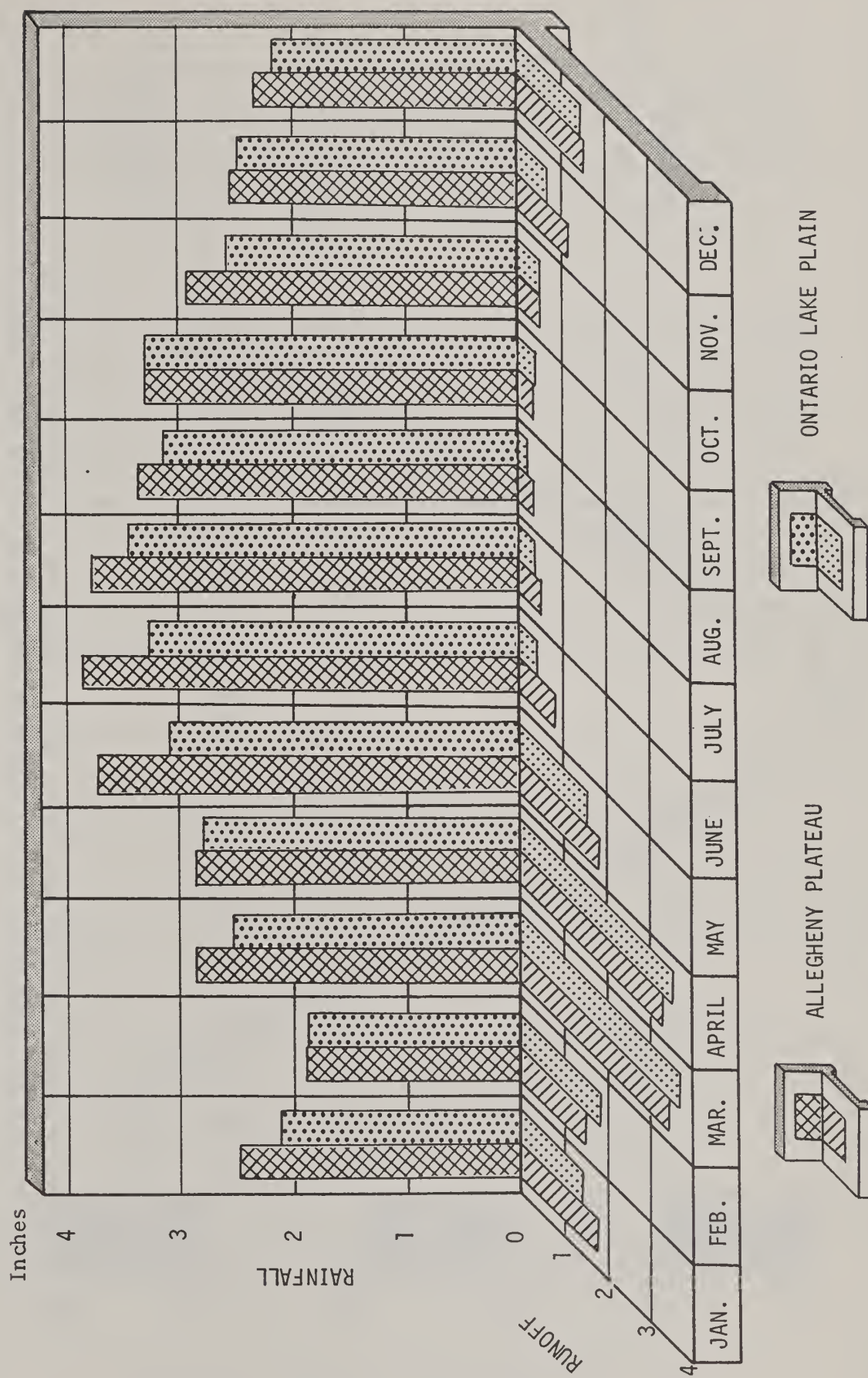
Temperature extremes recorded at the Buffalo station were a high of 99 degrees and a low of -20 degrees. Almost identical highs and lows were recorded at the Gowanda State Hospital station.

### GROWING SEASON

The length of the growing season is affected by elevation and the proximity to Lake Erie. Generally, the higher the elevation, the shorter and colder the growing season. Consequently, in the hilly southern section of the Basin, the growing season is approximately 135 days long. In the relatively flat northern portion, the growing season is increased to about 160 days.

Mean temperature for the growing season ranged from 60 to 65 degrees. Mean average rainfall for the growing season ranges from about 15 inches in the northern portion to about 18 inches in the south.

Figure 3.3 - A Comparison of Rainfall and Runoff Between the Allegheny Plateau and the Ontario Lake Plains.



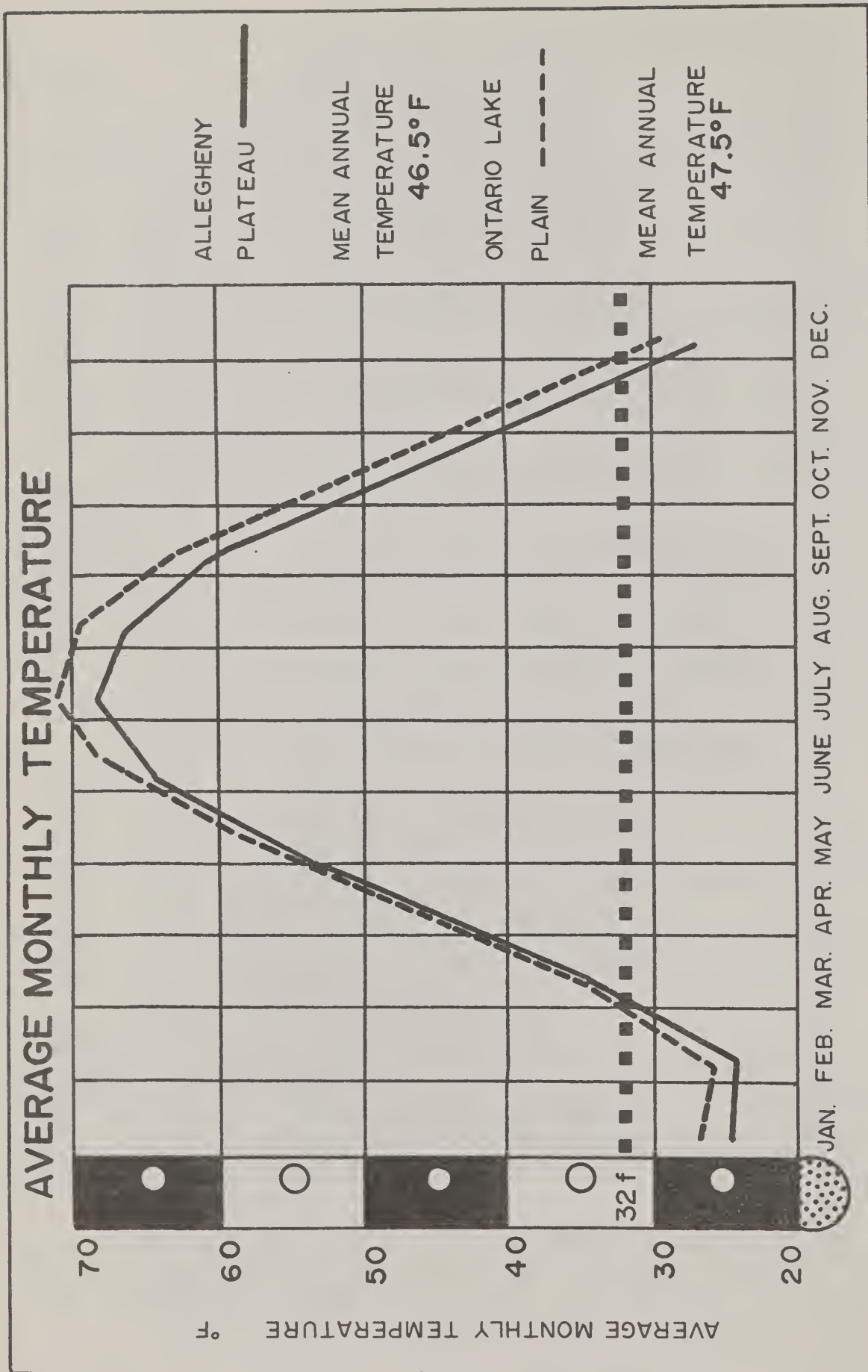


FIGURE 3.4

## WATER RESOURCES

Water of good quality is a basic necessity which has become critically important to society. Land use and management practices in the Basin strongly influence the quantity and quality of water available for rural households, municipalities and industry, livestock, crops and vegetation, navigation, and as a waste-dispersing agent. Also fresh, clear water for fish and wildlife and recreation is rapidly becoming a prime necessity.

### SURFACE WATER

The mean annual precipitation ranges from about 30 inches in the Ontario Plain to 40 inches in the Allegheny Plateau. Much of this precipitation soaks into the soil - some slowly reaching the ground water. Some also runs off the land into streams, ponds and lakes. The average annual runoff in the Ontario Plain is about 15 inches and ranges to about 19 inches in the Allegheny Plateau. (Figure 3.3). The most intense runoff occurs during the snowmelt period from February to April. Runoff is very slight during the summer months of June through August and accounts for less than 10 percent of the total. The greatest chance for intense runoff occurs during the month of March and the least chance during August and September.

Located in the Basin are 20 reservoirs having an area of 800 surface acres. No large natural lakes exist. There are more than 1,200 channel miles of brooks, creeks, and rivers in the Basin.

### GROUND WATER

Underlying the Basin are numerous water-bearing rock formations having considerable variation in ground water yields. Thick zones of permeable surficial deposits having high ground water yields are abundant locally although they are not uniformly distributed. Excellent yields from ground water sources can be found in such surficial deposits in the Cattaraugus Creek watershed and the Tonawanda Creek area south of Batavia. Other areas having similar potential lie along Eighteenmile Creek, the east branch of Cazenovia Creek, and Buffalo Creek.

Wells vary in depth, yield, and water level. Well depths range from 10 to 500 feet, and yields vary from a few gallons daily to more than 1,000 gallons per minute (gpm). Properly constructed wells in sand and gravel deposits yield 500 to 600 gpm in most valleys in the upland areas. In the Tonawanda Creek area wells in permeable deposits yield from 1,000 to 1,400 gpm. Several communities and industries are utilizing these high yield wells.

In the plateau area, ground water is hard, but generally has no other unfavorable characteristics. Ground water in the Ontario Plain region is high in dissolved solids, and is harder and otherwise poorer in quality when compared with that present in the plateau area. In Erie and Niagara

counties at the northern boundary of the Basin, ground water is high in sulfate and in some instances high in chloride. This condition is generally associated with the Camillus shale rock formation.

## WATER USE AND MANAGEMENT

Surface and ground water is being used to supply domestic, municipal, industrial, livestock and irrigation water. In addition, surface water is available for the numerous water-based recreational activities undertaken in the Basin.

Municipal water is supplied by numerous wells and the following reservoirs: Akron - 35 acres, Attica - 200 acres, Gowanda State Hospital - 55 acres, Orchard Park - 25 acres, and East Aurora - 3 acres. Lake Erie and the Niagara River are also used for water supply by metropolitan Buffalo and the communities served by the Erie County Water Authority.

The Lake as well as private ponds provide water-based recreational activities such as fishing, swimming and boating. Lake Erie is used by many individuals for recreation, but pollution and hazardous wind conditions limit these activities considerably.

Industrial water in the Buffalo-Niagara Falls area is satisfied by pumping from Lake Erie and the Niagara River. In other areas, high yield wells supply industrial water.

Water for irrigation of agricultural crops is mainly from streams, wells, and ponds. Irrigation of crops in the Basin is currently mainly in the Brant-Eden area.

Water management has centered around water quality as a result of heavy pollution to creeks and rivers. Raw or inadequately treated wastes, as well as sediment, land runoff, and industrial spills are major pollutants. In some areas where shallow wells exist in sand and gravel deposits, ground water pollution from septic system effluent has occurred. A detailed discussion of surface water pollution is contained in this report in Chapter 5.

Future water requirements have been investigated by several agencies and attempts are being made to meet future demands through better water management.

## FISH AND WILDLIFE RESOURCES

Presently, the Erie-Niagara Basin supports significant populations of many wildlife species. These species include white-tailed deer, ring-necked pheasant, ruffed grouse, 20 or more species of waterfowl, woodcock, cottontail rabbit, gray squirrel, racoon, muskrat, mink, beaver, woodchuck, red and gray fox, skunk, weasel and crow.

Habitat available for wildlife includes 670,000 acres for deer, and more than one million acres for small game. Waterfowl habitat consists of numerous small

bodies of water - natural ponds, marshes, farm ponds, and beaver flows. The largest area for waterfowl in the Basin is the 5,500 acre state-owned Tonawanda Game Management Area.

Trout fisheries include 34 streams having a length of 125 miles of fishing waters which vary from poor to excellent in their ability to support trout. The Cattaraugus Creek system contains the highest mileage as well as the best quality trout water. Trout ponds are few and no lakes or reservoirs are suitable for trout.

Warm water fisheries include 130 miles of streams and 380 acres of lakes and ponds. Lime Lake and Crystal Lake offer the best warm water fishing opportunity.

Urban expansion is encroaching on big and small game habitat and is significantly removing wildlife habitat in many areas. Posting of private lands to prevent hunter trespass is further reducing the area available for hunting. Posting is becoming more prevalent as summer or recreational residences are being acquired.

## QUALITY OF THE NATURAL ENVIRONMENT

The variety of agricultural land use combined with forested and brush areas in the rural sections provide a variety of scenic beauty. Visually pleasing rural scenes are provided by overlooks from higher elevations of the Allegheny Plateau. Natural scenic beauty is improved further when waterfowl and game animals are seen in their native habitat.

Well planned housing units with open space and vegetation integrated into the landscape enhances the aesthetics and living quality of the community environment.



SUMMER HOME IN SOUTHEASTERN PART OF THE BASIN

The quality of the environment is being jeopardized through air and water pollution, misuse and abuse of land, indiscriminant destruction of native vegetation and poor planning of urban, forested, and open areas and related facilities.

Urban areas, especially those with a concentration of industry, create serious conditions by discharging pollutants into the air and water. Municipalities and many industries are discharging poorly treated or untreated sewage into streams, thus destroying the resource for other uses. A secondary problem also results from this situation. Algal growth is stimulated by the nutrients which get into the water. This reduces the value of the water resource for recreation and also creates an offensive odor.

Indiscriminant destruction of native trees and shrubs during construction of housing units gives the development a "naked" and stereotyped look. Also no attempt is made to integrate open areas such as greenbelts, neighborhood parks, or recreational areas in developing communities. Moreover, many community service facilities lack imaginative landscape planning.

Poor planning construction and maintenance techniques cause heavy losses of soil to be eroded and then deposited in ditches, culverts, and streams. This sediment destroys the fishery of the stream as well as the stream's carrying capacity.

Probably one of the most obvious destructive factors is the carelessness of the population in keeping the aesthetics of the Basin pleasing to view. Open dumps, junk yards, carelessly kept land and housing units, and litter make the environment less desirable.

# ECONOMIC DEVELOPMENT

4.1

## HISTORICAL DEVELOPMENT

The Erie-Niagara Basin was settled more slowly than the eastern areas of New York State located along navigable streams and major land routes. Settlement of the area increased after the digging of the Erie Canal. But, the rate of growth was hampered because of the great distance in shipping goods to and products from the major areas of commerce. The earliest settlements in the Basin were along the Canal, Lake Erie, and larger streams.

When the first settlers arrived, the Basin was heavily forested. Trees were cut and burned to clear the land for crops. Frequently the first money the settlers earned from their farms was from the sale of potassium salts leached from the ashes.

Wheat was the first crop produced and was mostly exported. With the opening of new lands to the west with richer soils and more favorable topography, wheat production declined. Sheep and cattle production were the next major enterprises with the livestock being driven overland to eastern markets. Shortly after World War I, dairying increased significantly and is now the predominant type of farming.

## GENERAL DESCRIPTION

Located on Lake Erie and at the western end of the Barge Canal and served by all but two of the principal east-west railroads, Buffalo has long been a transportation center. As population centers have shifted south and west, Buffalo's strategic transportation position relative to national markets has weakened somewhat. However, it is still in a favorable position since there are over one hundred million people living within a 500-mile radius and the population of this market area is increasing faster than any other similar area in the United States.

The Basin population has grown from about 531,000 in 1900 to 1.2 million in 1960 with most of the growth concentrated in the Buffalo metropolitan area. Rural areas experienced only very modest growth during this period with the nonfarm residents increasing as longer commuting distances become more common. The Basin's growth rate for the 1950-1960 decade was close to 19 percent. This rate is about equal to the national rate for the same period but slightly greater than the 13 percent rate for the entire state. The Basin population is expected to increase to 2.1 million by the year 2020.

Unemployment has not been a serious problem although the area has lagged slightly behind national levels of employment during the 1950-1960 decade. A

recent study<sup>1/</sup> has projected a "job gap" between the number of potential jobs and the number of potential job seekers in the Buffalo area that will reach 40,000 by 1980 if present trends continue.

Growth in aggregate personal income in the Basin did not quite match that for the state and nation for the period from 1948 to 1961. The relative importance of agriculture as a source of personal income declined sharply during this period. Private sources are still the most important although they did decline somewhat.

Resources for future growth in the Buffalo SMSA appear to be adequate. There should be enough land suitable for development if growth rates in line with national projections are experienced. The Buffalo area has a reputation as a good place to live, providing many of the amenities that influence the location of new industry. A master plan for transportation has been developed including rail, air, and water as well as highways. A regional freeway-expressway system has been proposed to meet the future needs of the area.

## AGRICULTURAL AND RELATED ECONOMIC ACTIVITY<sup>2/</sup>

Dairying is the major type of farming in the Erie-Niagara Basin, although fresh market and processing vegetables, potatoes, and fruit are also important.

In 1959, the average farm size in the Basin was 127 acres, of which 54 acres were cropland harvested. This was an increase from 1949 of 26 acres in total acreage and 13 acres in cropland harvested.

Farms can be classified into one of two categories - noncommercial or commercial. These groups have significant economic and operational differences. Noncommercial farms include part-time, part-retirement, and abnormal farms.

Commercial farms include all farms with the value of farm products sold of \$2,500 or more. Also included are farms with sales of less than \$2,500, if the operator was under 65 years of age and did not work off the farm 100 days and if the nonfarm income was less than the value of products sold.

In 1959, there were an estimated 5,450 farms in the Erie-Niagara Basin. Of these, 62 percent or 3,393 farms were classified as commercial farms.

At this same time, 44 percent of the commercial farms had gross incomes in excess of \$10,000, 30 percent between \$5,000 and \$9,999 and the remaining 26 percent had gross incomes of less than \$5,000 (Table 4.1).

<sup>1/</sup> *A Growth Strategy for the Erie-Niagara Area: Part I, Economic Profile Erie-Niagara Area, pp. 8-10.*

<sup>2/</sup> *From The Agricultural Economy of the Erie-Niagara Basin.*

Table 4.1. Percentage Distribution of Commercial Farms  
by Level of Gross Receipts by Counties 3/

County	Percentage of Farms with Gross Income of:		
	: Over \$10,000 (Percent)	: \$5,000 to \$9,999 (Percent)	: Less than \$5,000 (Percent)
Allegany	31	39	30
Cattaraugus	37	34	29
Chautauqua	32	33	35
Erie	45	30	25
Genesee	47	28	25
Niagara	35	29	36
Wyoming	51	30	19
Basin Average	44	30	26

3/ Orleans County was omitted from tables due to the small portion of the county in the Basin.

While comparable data for the Basin is not available, the importance of farms with gross receipts of more than \$10,000 is indicated by the following information for New York State. In 1959, 45 percent of New York State's commercial farms (31 percent of all New York farms) had gross receipts from the sale of agricultural products in excess of \$10,000. The value of products sold from these farms was 76 percent of the total value of all products sold from all commercial farms, and 74 percent of the value of products sold from all New York State farms.

Noncommercial farms, or those with sales of less than \$2,500 were 31 percent of all New York farms, but produced only 3 percent of the total value of farm products sold. The remaining 38 percent of the farms sold 23 percent of the agricultural products.

Average values of land and buildings per farm and per acre for the Erie-Niagara Basin are shown in Table 4.2. Between 1949 and 1959, the value per acre increased over 50 percent and the value per farm nearly 165 percent.

Table 4.2 Average Value of Land and Buildings  
by Counties in 1949<sup>4/</sup> and 1959<sup>5/</sup>

County	Average Value per Farm		Average Value per Acre	
	: 1949	: 1959	: 1949	: 1959
<u>Dollars</u>				
Allegany	6,292	11,840	40	63
Cattaraugus	8,955	16,144	61	90
Chautauqua	8,845	18,864	92	166
Erie	13,195	32,234	161	297
Genesee	12,158	25,985	99	165
Niagara	10,892	22,560	148	267
Wyoming	10,446	21,842	67	118
BASIN AVERAGE	10,098	26,733	133	206

<sup>4/</sup> 1949 Census of Agriculture

<sup>5/</sup> 1959 Census of Agriculture

In 1959, about 72 percent of farm operators were full owners, 22 percent part owners, 1 percent manager, and 5 percent tenants. Recent changes in farm tenure have been dominated by an increase in the number of part owners as a percent of all operators, and a decrease in full ownership. The rapid increase in the proportion of farm operators who are part owners has been in response to changes in technology coupled with the unavailability of agricultural land and the greatly increased capital requirements.

## PRODUCTION OF AGRICULTURAL PRODUCTS

Total agricultural production in the Erie-Niagara Basin is dependent largely upon the acreage of crops grown, the yields per acre, the number of livestock on farms, and the production per animal. The distribution of cropland in the Basin is shown in Figure 4.1. Farmers in the Basin import fairly large quantities of grain from other areas of the United States and the quantity imported can be expected to increase in the future.

## LIVESTOCK AND LIVESTOCK PRODUCTS

Dairy production has increased from 335 million pounds of milk in 1939 to 560 million pounds in 1959, or over 67 percent. During the same time period, the increase was 68 percent for the Middle Atlantic Region. The Basin production represented 2.8 percent of the Middle Atlantic Region in both 1939 and 1959.



Numbers of cattle and calves sold have increased from 44,640 in 1939 to 64,350 in 1959, or over 44 percent. Middle Atlantic production showed slightly more than 42 percent increase for the same period. Basin production as a percent of Middle Atlantic production has remained a constant 2 percent from 1939 to 1959.

Sales of hogs and pigs increased from 16,655 in 1939 to 17,450 in 1959, or about 5 percent. This change, however, is the net result of a larger increase between 1939 and 1949, and a decrease from 1949 to 1959.

Sheep and lamb sales have decreased by over 46 percent from 12,580 to 6,750 between 1939 and 1959. The corresponding change for the Middle Atlantic Region was a 17 percent decrease.

Egg production has decreased by nearly 25 percent between 1939 and 1959, while it increased by nearly 53 percent during the same period in the Middle Atlantic Region.

Poultry meat production increased 14.8 percent from 1939 to 1959, while the Middle Atlantic Region's production for the same period increased 288 percent. This indicates an increasing importance of specialized areas in the Middle Atlantic Region, such as the Delmarva Peninsula.

The amount of livestock and livestock products sold in the Erie-Niagara Basin in 1959 and its relationship to the Middle Atlantic Region is summarized in Table 4.3.

## FIELD CROPS

Corn harvested for grain has increased by slightly over 76 percent between 1939 and 1959. During the same period, corn production increased 11.7 percent in the Middle Atlantic Region.

Corn cut for silage decreased nearly 7 percent between 1939 and 1959, while it increased nearly 21 percent in the Middle Atlantic Region during the same period. There is some indication that the use of corn silage has increased considerably since 1959.

Hay production has increased nearly 21 percent between 1939 and 1959, and during the same period, it increased nearly 39 percent in the Middle Atlantic Region.

Oats production has increased over 28 percent between 1939 and 1959, while the increase for the same period in the Middle Atlantic Region has been over 48 percent.

Wheat production has decreased by slightly more than 3 percent between 1939 and 1959. In the Middle Atlantic Region, the decrease was nearly 23 percent.

Table 4.3. Livestock and Livestock Products Sold in Portions <sup>6/</sup> of Counties Located in the Erie-Niagara Basin and in the Middle Atlantic Region, 1959.

County	Livestock or Livestock Products Sold, 1959									
	Whole Milk :	Cattle and :	Hogs and :	Sheep and :	Eggs :	Chickens :	Million Lbs.	Number	Number	Number
Allegany	2	225	18	51	4,923	3,958				
Cattaraugus	106	12,199	1,068	570	385,567	141,480				
Chautauqua	2	286	44	6	11,463	2,278				
Erie	222	28,645	11,955	2,110	3,110,390	551,694				
Genesee	81	8,061	2,408	2,819	978,523	74,231				
Niagara	16	2,291	1,336	521	428,871	34,240				
Wyoming	133	12,639	624	670	140,996	15,999				
Basin Total	562	64,346	17,453	6,747	5,060,733	823,880				
Middle Atlantic Region	20,009	3,237,004	2,087,488	824,982	567,236,543	295,056,634				
Erie-Niagara Basin as a percent of Middle Atlantic Region	2.8	2.0	0.8	0.8	0.9	0.3				

6/ 1959 Census of Agriculture

Dry bean production decreased nearly 86 percent between 1939 and 1959, and during the same period, it decreased nearly 32 percent in the Middle Atlantic Region.

Potato production decreased over 60 percent between 1939 and 1959, while in the Middle Atlantic Region the decrease was slightly over 14 percent.

The amount of field crops harvested in the Basin in 1959 and its relationship to the Middle Atlantic Region are summarized in Table 4.4.

## FRUITS AND VEGETABLES

The production of all fruits (in tons) has decreased approximately 2.5 percent between 1939 and 1959, while there has been a decrease of nearly 25 percent in the Middle Atlantic Region during the same period. Grapes, strawberries and apples are the most important fruits raised in the Basin.

Vegetable acreage has increased nearly 33 percent between 1939 and 1959, while in the Middle Atlantic Region, there was a 17 percent decrease during the same period. Vegetable production (in tons) has increased nearly 38 percent between 1949 and 1959. The Middle Atlantic Region's production for the same period has decreased by more than 8 percent.

Fruit and vegetable acreage and production for the Basin in 1959 and their relationships to the Middle Atlantic Region are summarized in Table 4.5. The acreages of major vegetable crops grown for 1940, 1950 and 1960 are presented in Table 4.6.

## FARM EMPLOYMENT

In 1959, 10,034 persons worked on farms at least part of the year in the Erie-Niagara Basin. Of these, 71 percent or 7,134 persons were family workers including farm operators and unpaid family labor. Of the 2,900 hired laborers, 1,937 worked 150 days or more, and 963 were seasonal workers.

Thirty-nine percent of the farm operators reported working off the farm 100 or more days in 1959. While no comparable data is available for the Basin, 3.4 percent of the New York farmers, whose sales of agricultural products exceeded \$10,000 had family incomes from off-farm work exceeding the value of agricultural sales. For farmers with sales of from \$2,500 to \$9,999, this figure reached 15 percent. Eighty-three percent of the farmers with sales of less than \$2,500 had off-farm incomes that exceeded the value of agricultural products sold.

7/  
Table 4.4. Field Crops Harvested in Portions of Counties Located in the Erie-Niagara Basin  
and the Middle Atlantic Region, 1959.

County	Field Crops Harvested, 1959											
	Corn	Corn										
	for	for										
	Grain	Silage	Hay	Oats	Wheat	Beans	Potatoes					
	Bushels	Tons	Tons	Bushels	Bushels	Cwt	Bushels					
Allegany	451	919	1,148	11,302	53	132	699					
Cattaraugus	32,711	36,465	55,914	325,267	7,206	* 8/	9,746					
Chautauqua	5,263	1,093	1,501	8,513	1,574	*	536					
Erie	317,754	105,653	115,452	1,028,471	239,103	1,200	264,028					
Genesee	191,595	45,390	39,469	473,747	209,546	8,006	229,871					
Niagara	92,433	7,661	13,438	212,188	102,561	2,061	10,686					
Wyoming	62,220	53,509	57,758	454,456	34,466	2,632	236,656					
Basin Total	709,427	250,690	284,680	2,513,944	594,509	14,031	752,222					
Middle Atlantic Region	133,462,249	8,660,274	13,181,762	69,029,423	32,640,022	863,231	54,768,719					
Erie-Niagara Basin as a percent of Middle Atlantic Region	0.5	2.9	2.2	3.6	1.8	1.6	1.4					

7/ 1959 Census of Agriculture

8/ \* Insignificant

Table 4.5. Fruit and Vegetable Acreage and Production in Portions of Counties Located in the Erie-Niagara Basin in the Middle Atlantic Region, 1959.

County	All Fruits		All Vegetables	
	Acreage	Production	Acreage	Production
	Acres	Tons 10/	Acres	Tons 11/
Allegany	* 12/	*	1	4
Cattaraugus	*	*	40	222
Chautauqua	480	1,920	133	747
Erie	4,392	17,568	16,877	94,511
Genesee	136	544	2,123	11,888
Niagara	1,212	4,848	594	3,328
Wyoming	160	640	276	1,545
Basin Total	6,380	25,520	20,044	112,245
Middle Atlantic Region	397,388	1,593,200	533,296	2,379,173
Erie-Niagara Basin as a percent of Middle Atlantic Region	Percent 1.6	Percent 1.6	Percent 3.6	Percent 4.7

9/ 1959 Census of Agriculture

10/Based on average yield of 4.0 tons per acre for New York State

11/Average yields were 5.6 tons per acre in New York State, 4.3 tons per acre for the Middle Atlantic Region

\* 12/Insignificant

Table 4.6. Acreages of Major Vegetable Crops Grown - 1939, 1949, 1959.

Crop	Acreage		
	1939	1949	1959
	Acres	Acres	Acres
Beets (Table)	192	233	248
Cabbage	1,037	913	510
Carrots	319	144	83
Cauliflower	363	398	619
Cucumbers	868	599	268
Peas	2,051	1,299	1,117
Snap Beans	2,895	6,030	12,076
Spinach	287	238	119
Squash	124	278	183
Sweet Corn	2,781	3,012	2,517
Tomatoes	2,219	3,000	1,607

## FOOD PROCESSING

Food processing plants in western New York are the major market for about two-thirds of the vegetable production. Food processing plants also take a large part of the fruit production both in the Basin and the Basin's economic subareas.

Of primary importance are the canning and freezing plants. Quantitative data on employment and wages for plants in the Erie-Niagara subareas was supplied by the New York State Department of Labor, Division of Employment. Figure 4.2 shows average employment and total payroll for the Erie-Niagara Economic Area. It indicates a small decline in employment between 1950 and 1963 of about 4.5 percent and a substantial increase in total payroll.

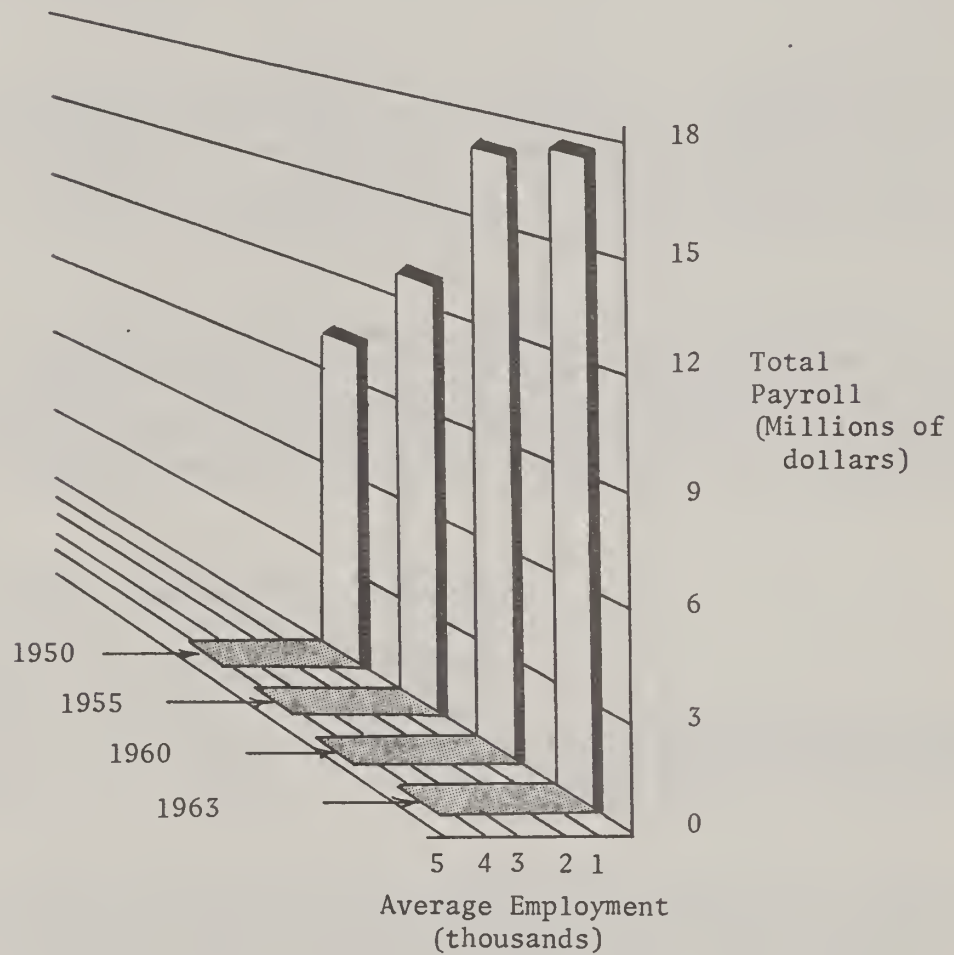
There are several problems related to growth in the food processing industry at their present location that involve land and water resources. One is the availability of land for plant expansion and the other is the availability of utilities, primarily of water supply and of waste water disposal. The results of a recent unpublished survey of food processing plants in western New York shows:

	EXCELLENT	SATISFACTORY	UNSATISFACTORY
	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Land for plant expansion	29	14	26
Availability of utilities	30	50	20
Availability of labor supply	3	77	20

Large plants employing over 500 persons were having more difficulty with land availability for expansion and labor supply than smaller plants. Size of plant does not appear significant with respect to water supply and waste disposal problems.

Food processing plants have large water demands for washing vegetables and for cooling cans. This use also results in water disposal problems. Water used for cooling gets heated to the point that dumping directly into streams could result in fish kill. Water used for washing carries large quantities of soil and organic material and cannot be dumped into streams. Some plants dispose of waste water by spreading it on grassland through an irrigation system. This works well if sufficient land is available. The amount of land needed for a given quantity of water to be disposed of would vary with the slope, internal drainage, and permeability of the soil and on the rate of disposal.

Figure 4.2. Average Unemployment Insurance Covered Payrolls  
for Selected Food Processing Industries 13/ 14/



13/ Includes Standard Industrial Classification Industries.

14/ For Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans, and Wyoming Counties.

Growth of the industry is also related to the competitive position of firms in Western New York with those found in other regions of the country. Of the firms reporting in a recent New York State survey, 73 percent reported that the growth of those firms in Western New York would be about the same as national growth, 18 percent reported that growth would be greater than national growth, and 9 percent reported that the growth would be less than national growth.

## PROJECTED NEEDS FOR AGRICULTURAL PRODUCTION

Projections of needs for agricultural production were made as follows:

1. National projections of future needs for products based on assumed populations growth, improvements in dietary standards, and expected changes in exports and imports were provided by the Economic Task Group of the Interim Water Resources Council. Middle Atlantic regional projections of future agricultural product needs were developed from the national projections by examination of past regional agricultural production trends relative to national production trends. These trends provide the basis for determining the Middle Atlantic's share of future national production requirements.

The national projections take into consideration interregional shifts and comparative advantage of different regions. Similarly, Basin requirements for future agricultural production were also developed by examining past trends in production as the basis for determining the Basin's share of Middle Atlantic production. Table 4.7 shows the current and projected requirements for farm products for the Basin.

2. Estimates of retirement from cultivation of less productive land were made based upon unpublished information compiled by the New York State College of Agriculture.<sup>15/</sup> This information covered: (a) the level of intensity that Basin farms were using in 1958, (b) the cropland acreage of the average farm in each intensity class, and (c) an estimate of the number of farms in each intensity class. Using this data and assuming that only those farms currently being used at the most intensive level would remain in farming in 2020, cropland acreage available for agricultural production for the decades from 1970 to 2020 was established (Table 4.8).

By the year 2020, less than half the present cropland is expected to be available for crop production. While this represents a substantial decline, it is not inconsistent with other projected declines in the Northeast. Most of the losses are expected to come from land that is not readily able to use modern farming technology.

<sup>15/</sup> Nobe, K.C., E.E. Hardy, and H.E. Conklin;  
*The Extent and Intensity of Farming in New York State.*

Table 4.7. Past and Projected Erie-Niagara Basin Requirements for Major Farm Products.

Commodity	Unit	:	:	:	Projections				
		1960	1970	1980	1990	2000	2010	2020	
		<u>Millions</u>							
Beef and veal	Lb.-Live wt.	23.0	27.0	30.0	35.0	41.0	45.0	52.0	
Lamb and mutton	Lb.-Live wt.	0.5	0.5	0.4	0.4	0.5	0.5	0.6	
Pork	Lb.-Live wt.	3.3	2.6	2.0	1.7	2.1	1.6	0.9	
Milk	Pound	617.0	674.0	801.0	941.0	1,104.0	1,303.0	1,500.0	
Chickens	Lb.-Live wt.	0.6	0.7	0.7	0.6	0.7	0.8	0.9	
Eggs	Number	88.0	72.0	64.0	64.0	63.0	59.0	68.0	
		<u>Thousands</u>							
Wheat	Bushe1	619.0	610.0	567.0	667.0	782.0	923.0	1,062.0	
Dry beans	Cwt.	17.6	7.9	4.9	0.0	0.0	0.0	0.0	
Potatoes	Cwt.	542.0	472.0	549.0	645.0	757.0	894.0	1,029.0	
Vegetables	Cwt.	2,839.0	4,285.0	5,787.0	7,566.0	9,552.0	11,673.0	13,735.0	
Fruit	Ton	23.0	31.0	42.0	52.0	65.0	80.0	92.0	



Some will move into urban uses, but much of it is expected to go into rural nonagricultural uses as currently these uses are outbidding agricultural uses for this land.

3. Crop yields for the decades from 1960 to 2020 were estimated by assuming a 2 percent annual increase in yields. The reasonableness of the yields in 2020 were assumed if the projected yield was within 10-15 percent of maximum yields currently obtained by farmers. Table 4.9 presents these projections.
4. For the decades from 1960 to 2020, production was estimated by projecting acreage and yield of individual crops. Initial analysis assumed present percentage distribution of acreage in each crop will continue. If a shortage of production occurs in future decades, adjustments were made in the crop mix to determine if the shortage could be met without resource development. Table 4.11 shows the resulting projections.

A comparison of Table 4.10 (Acreage Requirements) with Table 4.8 (Estimates of Availability of Cropland) indicates that the supply of available land will be adequate to meet product needs without resource development until 2010, with a small shortage indicated for 2020.

Future needs for water in agriculture and the associate economic value will depend on several factors. Among these are:

1. The combined effect on national requirements for agricultural products of (a) population growth, (b) improved dietary standards resulting from higher levels of income per capita, and (c) exports of agricultural products.
2. Shifts in economic advantage between agricultural regions of the country.
3. Effect on the availability of land for agricultural production because of (a) expanding nonagricultural use of land for highways, houses, factories, etc., and (b) retirement of less productive land from intensive agricultural use.
4. Advancements in agricultural technology resulting in improvements in the production and utilization of crops and pasture.
5. Opportunities for more intensive use of agricultural land and resources resulting in increases in output and associated costs.
6. Opportunities for resource development resulting in increases in output and changes in cost.

Table 4.9. Past and Estimated Crop Yields per Acre.

Crop	Unit	Projections					
		1960	1970	1980	1990	2000	2010 : 2020
		Acres					
Hay	Ton	2.0	2.3	2.8	3.4	4.1	5.0 6.0
Corn grain	Bushel	56.0	68.0	83.0	101.0	123.0	150.0 183.0
Corn silage	Ton	10.0	12.0	15.0	18.0	22.0	27.0 33.0
Oats	Bushel	55.0	67.0	82.0	100.0	122.0	149.0 182.0
Wheat	Bushel	29.0	35.0	42.0	51.0	62.0	76.0 93.0
Potatoes	Bushel	416.0	507.0	618.0	753.0	918.0	1,119.0 1,364.0
Dry beans	Cwt.	9.1	11.4	13.2	15.6	18.0	20.4 22.8
Cabbage	Ton	15.0	18.0	22.0	27.0	33.0	41.0 49.0
Peas	Ton	1.5	1.8	2.2	2.7	3.3	3.4 3.5
Sweet corn	Ton	2.2	2.7	3.3	4.0	4.9	5.9 7.2
Tomatoes	Ton	11.5	14.0	17.0	21.0	25.0	31.0 38.0
Snapbeans	Ton	1.7	2.1	2.5	3.1	3.8	4.6 5.6
Onions	Cwt.	320.0	390.0	476.0	581.0	709.0	864.0 1,053.0
Beets - processed	Ton	12.6	16.0	19.0	23.0	28.0	34.0 42.0
Carrots	Ton	15.0	18.0	22.0	27.0	33.0	40.0 48.0
Spinach	Ton	9.0	10.0	12.0	13.0	15.0	16.0 18.0
Broccoli	Ton	2.5	3.3	4.1	5.0	5.8	6.6 7.5
Cauliflower	Ton	8.0	9.0	10.0	11.0	12.0	13.0 15.0
All vegetables	Ton	6.1	7.5	9.0	10.8	12.8	15.3 18.2
All fruit	Ton	3.6	5.2	7.0	8.7	10.8	13.3 15.3
Apples - processed	Bushel	300.0	400.0	600.0	1,000.0	1,500.0	2,200.0 3,000.0
Permanent pasture	Feed Unit	480.0	560.0	640.0	720.0	800.0	880.0 960.0
Cropland pasture	Feed Unit	1,000.0	1,160.0	1,320.0	1,500.0	1,680.0	1,820.0 2,000.0

Table 4.10. Past and Projected Acreage Requirements to Meet Product Needs

Crop	:	1960	:	1970	:	1980	Projections							
							:	1990	:	2000	:	2010	:	2020
<u>Acres</u>														
<u>Feed Crops</u>														
Corn Grain		12,700		10,600		9,100		8,000		7,200		6,300		5,700
Oats		45,700		38,200		32,900		28,900		25,800		22,700		20,500
Hay		142,400		123,600		106,800		94,200		85,100		75,200		69,000
Corn Silage		25,100		20,900		17,600		15,700		14,000		12,300		11,100
Cropland and Pasture		61,200		52,800		48,800		46,000		44,700		44,500		44,600
Subtotal		287,100		246,100		215,200		192,800		176,800		161,000		150,900
<u>Non-Feed Crops</u>														
Wheat		21,300		17,400		13,500		13,100		12,600		12,100		11,400
Dry Beans		2,000		700		400		0		0		0		0
Potatoes		2,200		1,600		1,500		1,400		1,400		1,300		1,300
Vegetables		23,300		28,600		32,200		35,000		37,300		38,100		37,700
Fruit		5,800		6,000		6,000		6,000		6,000		6,000		6,000
Subtotal		54,600		54,300		53,600		55,400		57,300		57,500		56,400
Miscellaneous Crops		13,800		12,000		10,700		9,900		9,400		8,700		8,300
TOTAL - Cropland		355,500		312,400		279,500		258,100		243,500		227,200		215,600
Permanent Pasture		138,000		118,000		109,000		103,800		101,800		99,700		100,600

Table 4.11. Past and Projected Water Requirements for Various Consumptive Users

Type of User or Product	:	:	:	Projections						
	1960	1970	1980	1990	2000	2010	2020			
	M I L L I O N   G A L L O N S									
Milk	802.1	741.4	801.0	894.0	1,004.6	1,146.6	1,290.0			
Beef and veal	207.0	243.0	270.0	315.0	369.0	405.0	468.0			
Lamb and mutton	4.8	4.8	3.8	4.8	4.8	4.8	5.8			
Pork	27.4	21.6	16.6	14.1	17.4	13.3	7.5			
Chickens	0.1	0.1	0.1	0.1	0.1	0.1	0.1			
Eggs	15.0	12.2	10.9	10.9	10.7	10.0	11.6			
Fruit	23.6	24.6	24.6	24.6	24.6	24.6	24.6			
Domestic										
Rural, nonfarm	2,664.9	3,256.0	5,691.8	9,460.8	13,728.0	18,911.7	24,979.8			
Rural, farm	331.6	291.0	371.8	456.8	511.1	495.1	394.8			
TOTAL	4,076.5	4,594.7	7,190.6	11,181.1	14,670.3	21,011.2	27,182.2			

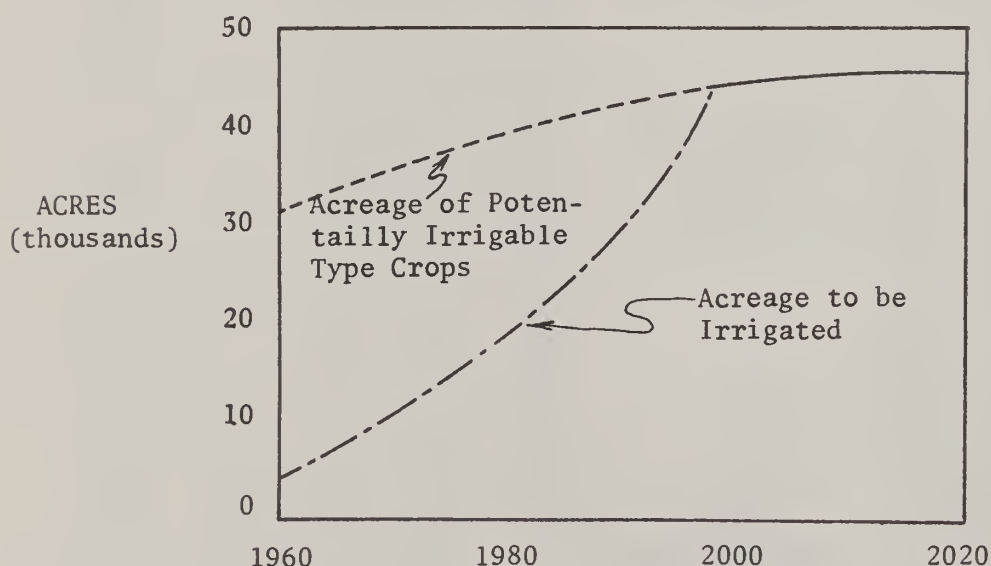
## ESTIMATED NEEDS FOR IRRIGATION WATER

There are approximately 4,700 acres now being irrigated in the Basin and it is the opinion of researchers, extension specialists and other agricultural leaders that irrigation will expand in the future, particularly on high value crops such as vegetables, potatoes and fruit.

Estimates of future irrigation needs were based upon the projected acreage requirements for vegetables, potatoes, and fruit presented in Table 4.10. One of the assumptions used in making these projections was that all fruit and vegetable acreage will be irrigated by the year 2000. Based on this assumption, irrigated acreage would reach 44,700 acres by the year 2000 or more than a tenfold increase in 40 years.

Rates of increase in irrigated acreage in the Erie-Niagara will have to accelerate considerably if projected fruit, vegetable and potato acreage will all be irrigated by 2000. In 1959 an estimated 14 percent of the acreage of potentially irrigable crops were irrigated. If a straight line relationship between this figure and 100 percent irrigation in 2000 is used as a guide to estimate the proportion irrigated between these two points of time, the estimated acreage irrigated in the early part of the period appears quite high in light of the present situation. Therefore, these proportions were adjusted to reflect acreages that appear more realistic for the near future (Figure 4.3).

Figure 4.3. Estimates of Acreages of Potentially Irrigable Type Crops and Potential Acreage to be Irrigated



These figures are estimates and it is not known to what degree irrigation practices will be employed by the Basin farmers. To date, adoption of irrigation by farmers is still in the early stages. It is not known to what extent the lack of an economical and adequate water supply has retarded the rate of adoption by farmers. Adoption tends to accelerate greatly during crises drought periods and slack off during times of adequate moisture. Given economical and adequate supplies of water, it is not improbable that irrigated acreage would expand to the degree estimated, particularly if a crisis period occurs.

Irrigation appears to be gaining a wider acceptance in the eastern United States and is being used increasingly to improve and stabilize crop quality and yields rather than just for saving a crop during periods of drought.

## PROJECTED NEEDS FOR RURAL DOMESTIC AND LIVESTOCK WATER SUPPLY

Projections of rural domestic water needs were developed from projections of farm and rural nonfarm population. Livestock and orchard spray needs are based on projections for agricultural production, application rates and future individual requirements. Table 4.11 presents the projections of water requirements for various rural consumptive uses.

## FOREST RESOURCES AND RELATED ECONOMIC ACTIVITY

### EXTENT AND NATURE OF THE RESOURCE



FOREST LAND

Forest land in the Erie-Niagara Basin covers approximately 306,000 acres or about 24 percent of the total land area (Table 4.12). This forest land is found mostly in scattered tracts in the southern portion of the Basin. Niagara County is only 5.9 percent forested while Allegany County is 59.4 percent forested, (Figure 4.4).

The *New York State Soil and Water Conservation Needs Inventory* gives a clear indication of future trends in land use within the Erie-Niagara Basin. A 16 percent increase in forested land from 1958 to 1975 was forecast in this report. All of the eight counties are expected to increase except Orleans which is expected to decrease by one percent.

Forest lands consist of second-growth hardwood species and plantations of coniferous species that have been established on many abandoned farm areas. Most of the hardwood stands have been cut over one or more times. There are scattered stands of sawtimber size, but pole size and smaller timber predominates. Figure 4.5 shows forest land acreages by stand size for the Basin.

Ninety percent of the 290,340 acres of commercial forest land is privately owned. This is divided evenly between farmers and other private owners such as professional people, businessmen, housewives, factory workers and forest-based industries.

Ninety percent of the commercial forest land in public ownership is owned by the State of New York. County and local governments hold the remainder.

Hardwood forest types make up 98 percent of the forest land. The northern hardwood type of sugar maple, beech, yellow birch, and in the southern section, black cherry, is the most common. Black ash, red maple, and elm are the second most common occurring types. The only major softwood type is white pine-hemlock, (Table 4.13).

#### VOLUME OF SAWTIMBER AND GROWING STOCK

The total sawtimber volume (volume in trees over 9" D.B.H. for softwood and 11" for hardwood) for the Basin is approximately 950 million board feet. Genesee and Wyoming Counties have the highest sawtimber volume per acre. Subregion I, the counties of Erie and Niagara, due to a larger acreage in forest land have the most sawtimber. Growing stock, those trees of commercial species 5" and over D.B.H., is about the same on all forested land throughout the Basin.

#### CURRENT AND PROJECTED GROWTH

The status of the timber resource of the Basin will determine the feasibility of increasing lumber and wood pulp production. The relatively small portion of the total land area that is in forest is of good quality and capable of producing substantial quantities of high grade timber.

Table 4.12. Acreage of Commercial and Noncommercial Forest Land, 1964<sup>16/</sup>

Subregion and County	17/:		18/:		:		:		Percent of	
	Commercial Forest	Noncommercial	Total Forest	NonForest.	All Land	Forest	Commercial	Forest	Commercial	Forest
I Erie	143,100	4,900	148,000	504,850	652,850	21.9				
Niagara	4,204	66	4,270	67,220	71,490	5.9				
Subtotal	147,304	4,966	152,270	572,070	724,340					
II Allegany	1,900	-	1,900	1,300	3,200	59.4				
Cattaraugus	66,556	11,034	77,590	127,980	205,570	32.4				
Chautauqua	2,400	-	2,400	5,600	8,000	30.0				
Subtotal	70,856	11,034	81,890	134,880	216,770					
III Orleans	-	-	-	580	580	-				
Genesee	21,170	-	21,170	118,100	139,270	15.2				
Wyoming	51,010	-	51,010	134,080	185,090	27.6				
Subtotal	72,180	-	72,180	252,760	324,940					
TOTAL	290,340	16,000	306,340	959,710	1,266,050					

<sup>16/</sup> Figures updated from 1950 Forest Survey of New York.

<sup>17/</sup> Commercial Forest: Forest land which is capable and suitable for producing crops of industrial wood. Includes both accessible and inaccessible acres and land not withdrawn from timber use by statute or administrative regulation. Generally of a site quality capable of producing at least 20 cu.ft. per acre of annual growth.

<sup>18/</sup> Noncommercial Forest: All other forest land.

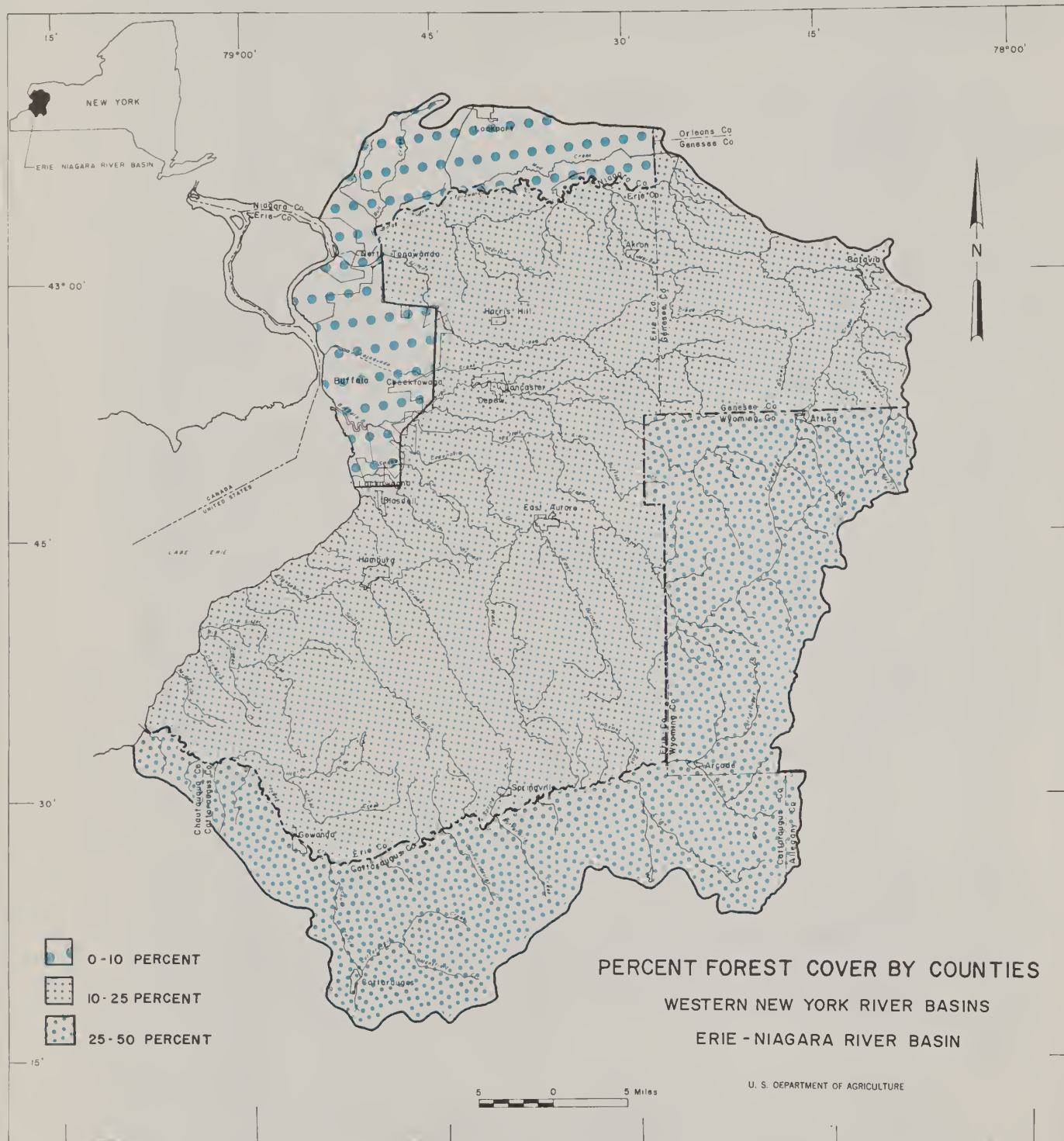
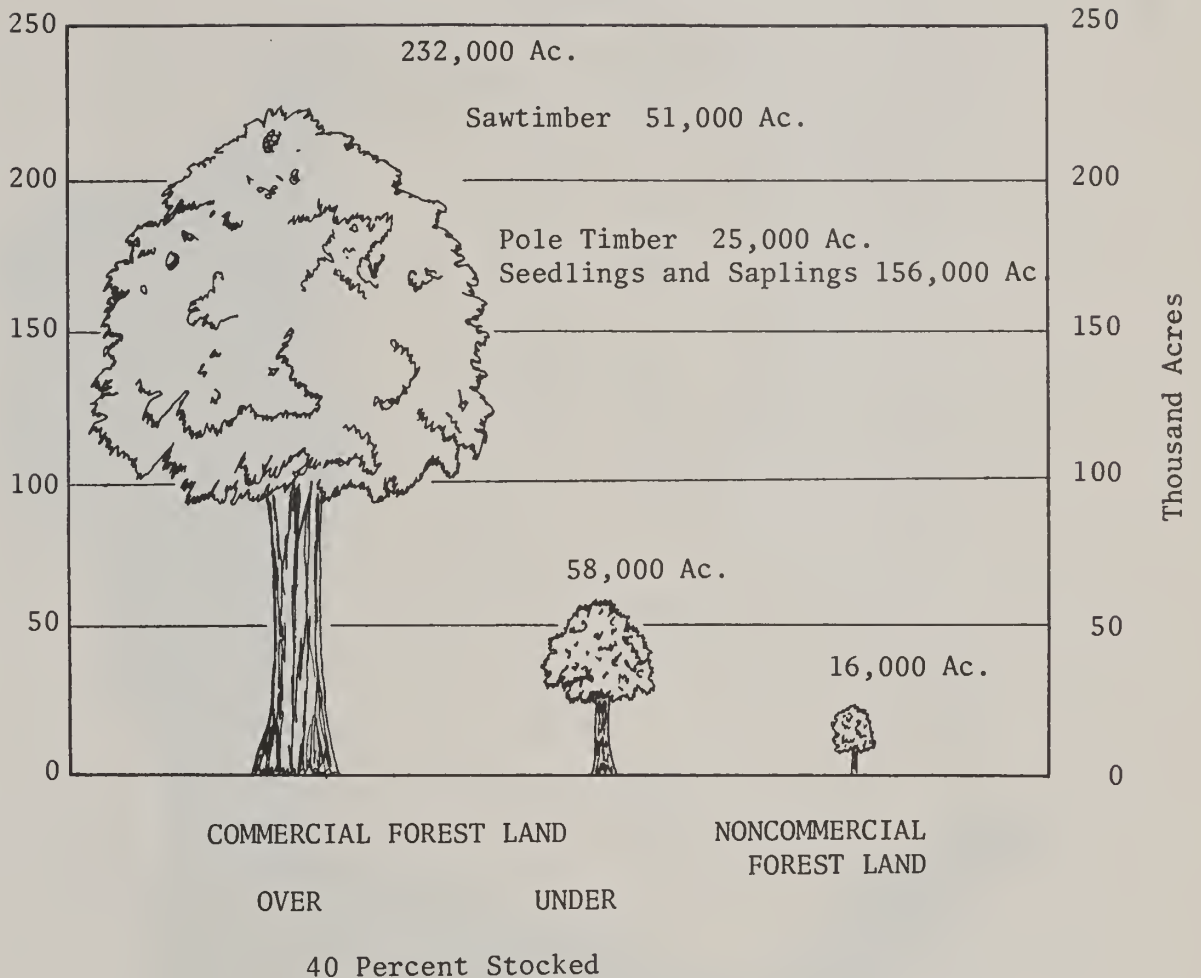


FIGURE 4.4

Figure 4.5. Forest Land Acreages by Stand Size



The Erie-Niagara Basin economic area is broken down in three economic sub-areas as shown on Figure 4.6. More than twice the commercial forest land is found in the Erie-Niagara or metropolitan subarea than in either one of the other two areas. Table 4.12 gives the breakdown of commercial and noncommercial forest land by economic subareas.

Information collected and compiled by the Forest Service <sup>20/</sup> concerning the present forest resource and likely timber growth under various levels of

<sup>20/</sup> Forest Service, *Projected Employment and Production in the Forest Industries and Forest Resource Statistics for Economic Areas of the Erie-Niagara Basin*.



Table 4.13. Acres of Commercial Forest Land by Forest Type, 1965.  
19/

Subregion and County	Softwoods			Hardwoods					Total	
	: White	: Pine &	: Hemlock	: Total	: Northern Hardwood	: Black Ash, Maple, Elm	: Oak	: Hickory	: All Other	: Total
I Erie	3,870	-	-	3,870	59,810	25,960	-	-	53,460	139,230
Niagara	-	-	-	-	-	-	4,204	-	-	4,204
Subtotal	3,870	-	-	3,870	59,810	25,960	4,204	-	53,460	143,434
II Allegany	130	664	60	130	1,460	-	-	150	160	1,770
Cattaraugus	664	60	60	664	49,900	860	9,220	50	5,910	65,892
Chautauqua	60	60	60	60	1,150	510	-	-	630	2,340
Subtotal	854	60	60	854	52,510	1,370	9,420	50	6,700	70,002
III Orleans	-	-	-	-	-	-	-	-	-	-
Genesee	-	-	-	-	5,630	14,730	-	-	810	21,170
Wyoming	-	-	-	-	30,890	6,780	4,170	-	9,170	51,010
Subtotal	-	-	-	-	36,520	21,510	4,170	-	9,980	72,180
TOTAL	4,724	60	60	4,724	148,840	48,840	17,794	-	70,140	285,616
										290,340

19/ Figures updated from *Projected Employment and Production in the Forest Industries and Forest Resource Statistics, for Economic Areas of the Erie-Niagara Basin.*

timber inventory in the Basin was analyzed. A comparison of this information with projected timber drain based on projected levels of production of lumber and pulpwood industries indicated the following:

1. Overall timber growth at the present time exceeds the current level of cutting.
2. Overall levels of projected timber growth for the major forest type for target years exceed projected levels of cutting for the Basin as a whole.

Thus, projected production of lumber and woodpulp for target years appears to be within the quantities of timber likely to be available for these industries under the assumptions that were made. It is possible, however, that future timber quality and unforeseen changes in forest ownership and land use may modify the projected availability of timber in specific sections. A very large volume of timber could effect an improvement in timber quality which in turn might attract new industries. On the other hand, the urban sprawl and public demand for recreation may exclude substantial volumes of timber for cutting. These possibilities are such that they are beyond reasonable prediction; however, they are possibilities that should be kept in mind.

## EMPLOYMENT IN FOREST PRODUCT INDUSTRIES

### LUMBER AND WOOD PRODUCTS

Projections of employment in primary manufacturing of lumber were made by determining productivity trends from appropriate employment and production data for New York. Estimates of future productivity levels are based on past regional and national trends <sup>21/</sup>. Projections of future employment in economic subareas were made by dividing projected lumber output for target years, (Table 4.14) by projected levels of output per employee. The resulting employment projections are shown in Table 4.15.

Employment in the secondary manufacturing segment of the lumber industry in the Erie-Niagara Basin is expected to remain fairly constant. Projections of employment (Table 4.15) are based on (1) historical employment trends in this industry group, (2) assumptions regarding average annual increases in employment, and (3) upon estimates of likely increase in the overall activity of this portion of the lumber industry. The combined effects of a net increase in activity and an increase in labor productivity are expected to lead to relatively constant employment throughout the Basin from 1960 to 2000, after which a moderate decrease is expected.

<sup>21/</sup> Zaremba, Joseph; *Economics of the American Lumber Industry*, Chapter 6.

Table 4.14. Past and Projected Production of Lumber, Woodpulp, and Paper and Paperboard.

		Year						
		1950	1960	1970	1980	1990	2000	2020
Million Board Feet								
Lumber Production								
Subarea:	I	8.0	7.7	7.6	7.6	7.4	7.3	7.3
	II	39.2	29.7	34.4	38.2	46.5	55.9	67.4
	III	3.9	3.6	4.0	5.6	6.8	7.1	8.9
TOTAL		51.1	41.0	46.0	51.4	60.7	70.3	83.6
Thousand Tons								
Woodpulp Production								
Subarea:	I	60	120	130	140	150	165	185
	II	-	-	-	-	10	10	20
	III	-	-	-	10	15	20	25
TOTAL		60	120	130	150	175	195	230
Thousand Tons								
Paper and Paperboard Production								
Subarea:	I	100	210	240	260	270	290	330
	II	-	-	-	10	20	25	35
	III	30	30	40	40	45	50	65
TOTAL		130	240	280	310	335	365	430

Table 4.15. Past and Projected Employment in the Lumber and Wood Products Industry.

		Year						
		1950	1960	1970	1980	1990	2000	2020
Primary Employment								
Subarea:	I	100	100	100	100	* 22/	*	*
	II	600	400	400	400	400	400	300
	III	100	*	100	100	100	*	*
TOTAL		800	500	600	600	500	400	300
Secondary Employment								
Subarea:	I	1,100	1,500	1,700	1,500	1,400	1,300	1,100
	II	700	400	300	200	100	100	*
	III	100	100	100	*	*	*	*
TOTAL		1,900	2,000	2,100	1,800	1,500	1,400	1,100
TOTAL ALL EMPLOYMENT		2,700	2,500	2,700	2,400	2,000	1,800	1,400

22/ Less than 50 persons

## PAPER PRODUCTS

Employment in the primary manufacturing segment of the pulp and paper industry was projected using the projections of production given in Table 4.14 and assuming an increase in productivity of paper and paperboard output per employee.

Projected output was then divided by productivity figures to determine the employment projections shown in Table 4.16.

Employment in the secondary part of paper and allied products industry was projected assuming a productivity increase of 2.1 percent in terms of output per employee. Major types of paper and paperboard used in secondary production are coarse papers, container board and bending board. Production of these paper types is expected to increase on an average annual weighted average rate of 3.2 percent. <sup>23/</sup> Employment projections in pulp and paper manufacturing industry are shown in Table 4.16, therefore, were made assuming a growth in product output of 3.2 percent per year and an annual increase in employee productivity of 2.1 percent.

## FORESTRY

Forestry is a relatively minor employment group in the Erie-Niagara Basin. Included in forestry is employment in establishments primarily engaged in such activities as forest nurseries, reforestation, forestry services, maple products, and other forest products. It does not include forestry employment accounted for elsewhere, such as employment of foresters by manufacturing industries.

Projections of employment in forestry show a nearly constant employment level through the projection period to the year 1990 after which time moderate increases in employment seem likely. It appears likely that this increase will take place in forest nurseries and in forestry activities.

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<sup>23/</sup> U. S. Forest Service *Timber Trends in the United States*.

Table 4.16. Past and Projected Employment in the Pulp and Paper Manufacturing Industry.

		Year						
		1950	1960	1970	1980	1990	2000	2020
Primary Employment								
Subarea:	I	1,500	2,900	2,700	2,300	2,000	1,900	1,600
	II	-	-	-	* 24/	100	100	100
	III	300	300	300	300	300	300	300
SUBTOTAL		1,800	3,200	3,000	2,600	2,400	2,300	2,000
Secondary Employment								
Subarea:	I	1,500	5,800	6,000	6,200	6,300	6,400	6,500
	II	100	100	100	100	100	200	200
	III	400	300	300	300	300	400	400
SUBTOTAL		2,000	6,200	6,400	6,600	6,700	7,000	7,100
TOTAL ALL EMPLOYMENT		3,800	9,400	9,400	9,200	9,100	9,300	9,100

24/ Less than 50 persons

## WATER AND RELATED LAND RESOURCE PROBLEMS AND NEEDS

Water and related land resources are constantly changing and must be continuously measured and studied if we are to use these resources wisely and eventually manage them for man's benefit.

This chapter provides a recorded measurement of the water and related land resource problems in the Erie-Niagara Basin and the resulting development needs. Major emphasis is on the problems within the agricultural and forestry community and on the needs which could be satisfied through the United States Department of Agriculture programs. Other federal and state agencies are responsible for the problems within or near urban areas such as Buffalo and Batavia.

Figure 5.1 shows the location of (1) floodwater damages totaling approximately \$1.5 million per year, (2) over 135 miles of polluted streams, and (3) eight locations which have water supply systems that are inadequate or not fully developed.

Irrigation is being practiced on over 4,700 acres now and is expected to increase to 44,700 acres in the next 40 years. This will require greater amounts of water, principally from ground water and reservoir sites.

Inadequate drainage is a problem on approximately 91,000 acres. Group action and on-farm drainage improvements are needed to increase agricultural production on the diminishing amount of available cropland.

Available cropland is expected to decrease from a present 439,700 acres to 204,500 acres by the year 2020. This supply of cropland will be adequate to meet product needs without resource development until 2010 with a small shortage indicated for 2020. Zoning or other controls to prevent unwise urban expansion is needed, in such areas as Lower Tonawanda Creek, to insure proper utilization of lands better suited to agriculture.

Soil erosion, excess water, and shallow and droughty soil conditions are problems on more than 30 percent, or about 414,000 acres, of the total Basin area. All forest lands need continual protection from fire.

Scouring of streambank is the principal erosion problem contributing to sediment deposition problem. Sheet erosion generates from 100 to 1500 tons of sediment per square mile.

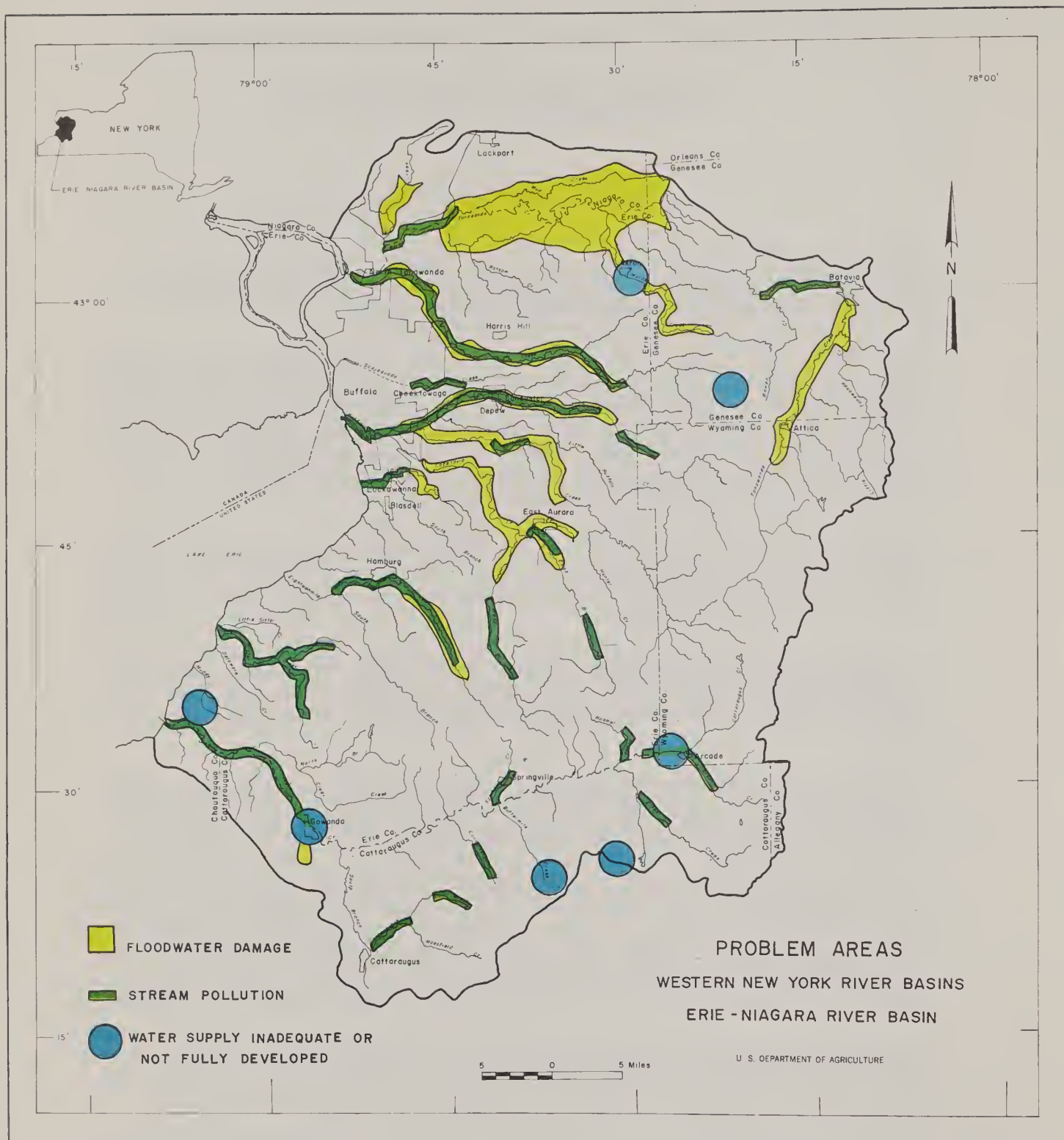


FIGURE 5.1

Stream pollution in the Basin is primarily caused by inadequately treated industrial and municipal waste discharge, and sediments from upland areas.

Ever-increasing number of people participating in recreation and fish and wildlife activities place great demands on present facilities and available land. The demand for more water-based recreation indicates a need for more surface waters and cleaner streams and lakes. More public and private land must be open to the public for all recreation uses.

## FLOODWATER

Major floodwater damages are located in the northern half of the Basin. Here, runoff concentrates rapidly from the steep upland areas and spreads out over the lowlands where the stream gradient and the land becomes flat. Streams in the southern half of the Basin are deeply entrenched which confines flooding to narrow flood plains between steep valley walls.

The U. S. Army Corps of Engineers, the Division of Water Resources, and the Soil Conservation Service estimate that over 55,000 acres are affected by floodwater causing an estimated average annual damage of approximately \$1,530,900 (Table 5.1). Most of the monetary damage is a result of urban flooding along Tonawanda Creek, Scajaquada Creek, and Cazenovia Creek. About 27,000 acres of the total area flooded are located in the lower portion of Tonawanda Creek. It is recognized that higher damage values will occur if urban expansion is allowed to take place on the flood plains.

Table 5.1. Estimated Floodwater Damages Along Major Streams and Their Tributaries.

Location	Acres Affected	Estimated Average Annual Damages (Dollars)
Tonawanda Creek	34,500	463,400
Ellicott Creek	10,400	244,500
Scajaquada Creek	500	185,500
Cayuga Creek	2,500	36,400
Buffalo Creek	2,200	38,400
Cazenovia Creek	3,400	181,200
Smokes Creek	500	22,700
Cattaraugus Creek	1,100	358,800
TOTALS	55,100	1,530,900

Ice jamming on the streams sometimes increases the floodwater problem. This is especially true on flat gradient meandering streams and at the mouths of many streams along the shore of Lake Erie.

This report concentrates upon flood problems affecting agricultural lands and rural communities. The Corps of Engineers and the New York State Division of Water Resources are investigating flood problems within or near urban areas such as Buffalo and Batavia.

Figure 5.2 shows the floodwater problem areas located within the agricultural community and which might be applicable to a United States Department of Agriculture small watershed program. The areas shown represent a total of 22,430 acres flooded with a resulting average annual damage of \$102,700. Table 5.2 lists the type of damage area and other pertinent data for each area.

Table 5.2. Floodwater Damages in Areas Studied by USDA.

Location	: Watershed : Number	: Type of : Damage	: Acres : Flooded	: Estimated : Average Annual : Damage
Tannery Brook	1	Urban	40	\$ 38,000
Slate Bottom Creek	1	Agric.	240	Minor
Eighteenmile Creek	56	Agric.	600	Minor
Ellicott Creek	57	Agric.	1,500	\$ 9,500
Upper Tonawanda Creek	148	Agric.	3,000	\$ 15,000
Lower Tonawanda Area	238,239 241,245	Agric.	16,000	\$ 31,200
Murder Creek	240	Agric.	1,050	\$ 9,000
TOTALS			22,430	\$102,700

Flooding was not investigated along Buffalo Creek, Cayuga Creek, and Cazenovia Creek since each of these streams has undergone considerable examination when analyzed as the Buffalo Creek Flood Prevention Project by the United States Department of Agriculture. It is felt that conditions have not changed significantly to warrant further investigation of a program to alleviate the remaining floodwater damages along the three creeks.

Problems and needs of each floodwater damage area studied by the USDA (Figure 5.2) are discussed in the following paragraphs.



## TANNERY BROOK

Floodwater from Tannery Brook affects about 40 acres of urban property in the village of East Aurora, Erie County. Average annual damage is estimated to be \$38,000. Structural measures are needed to reduce the floodings which occur almost annually. Additional details on Tannery Brook can be found in Appendix B.

## SLATE BOTTOM CREEK

Slate Bottom Creek is a tributary of Cayuga Creek. The total number of acres inundated on the main stem of the creek at the 100-year frequency flood is approximately 240 acres.

Outlined on an aerial photo in Appendix B, Figure B-1, is generally a well defined, narrow, flood plain which is uninhabited. Average annual damage to agricultural lands, roads and bridges, and average annual indirect damage resulting from the interrupted flow of traffic are insignificant.

Overtopping at four of the eight bridges on the main stem occurs when the 100-year frequency flood is considered. These bridges are at Borden Road, Transit Road, Aurora Street, and Brunck Road.

Some channel relocation has taken place in two areas. They are upstream from Borden Road for a distance of about 2,300 feet and between French Road and the abandoned railroad yard tracks for a distance of about 2,000 feet. The purpose of these relocation projects is to straighten the creek to provide room for urban developments.

Some generalizations may be made as to what affect the new alignment may have on flooding. The flood plain within the watershed has a well defined first bottom, and in some cases, second bottom area where flood flows can be contained. The new channel alignments have eliminated the flow area provided by the first and second bottom. Unless the new channel flow area equals that of the old flood plain, adequate capacity will not be provided and floodwater damages can be expected. Since the new channel capacity and flood plain geometry are not known at this time, more specific information cannot be provided.

## EIGHTEENMILE CREEK

Flooding on about 600 acres from the city of Hamburg upstream to the hamlet of Boston was studied. Only minor damages were identified.

Floodwater problems in the study area are confined mainly to the bottomland area just south and east of Hamburg. Route 219 will flood at the 10-year

frequency from Newman Creek. All other bridges along the main stem have a capacity great enough to carry the 10-year flood. The 100-year flood will inundate all roads crossing the valley through the study area except Polish Hill Road north of Boston. Also, the 100-year flood line is estimated to overtop Route 219 between Hamburg and North Boston near Dorst Road. Commercial and residential damages are considered insignificant when considering present flood plain use.

Soils in the flood plain are generally deep and well drained. Apartment units and housing developments have been constructed on the flood plain near North Boston and Boston.

Total crop and pasture damages under present conditions are estimated to be \$9,500 annually.

Residential and other types of damage are known to exist particularly in the lower reaches. These damages are greater in magnitude than the agricultural damages. No attempt was made to measure the magnitude of these damages.

The flood plain from the village of Alden to the Erie County Penitentiary is in relatively low intensity land use within the 100-year flood limits. There are small acreages of crop and pasture land but for the most part land use consists of forest land or idle. Consequently, no serious flood damages currently exist in this reach, but any future urban encroachment on the flood plain would receive extensive property damage.

## TONAWANDA CREEK

In this report, the flood plain of Tonawanda Creek is divided into the upper and lower drainage areas. The Upper Tonawanda Creek includes that area from its headwaters in Wyoming County to the hamlet of Bushville, west of the city of Batavia. The Lower Tonawanda area encompasses the remaining drainage of that creek including Ellicott, Mud, and Murder Creeks. Ellicott and Murder Creeks are treated under separate headings in this report.

### UPPER TONAWANDA CREEK

The major areas of inundation extends from the village of Attica to the city of Batavia. This flood plain area is characterized by flat, low gradient lands, subject to annual inundations occurring mainly in the spring.

An estimated 4,600 acres of agricultural land is subject to frequent flooding. The majority of these lands are capable of supporting a more intensive agricultural use under flood free conditions. It is estimated that floodwater damage to crops and pastures amounts to \$15,000 per year. Increases in net income may also be realized through a change in the use of land once relieved of the frequent flood problems.

## LOWER TONAWANDA AREA

The Lower Tonawanda area offers one of the greatest physical potentials for agricultural development in the Basin. This is a 40,000 acre area where Tonawanda Creek floodwater directly affects about 16,000 acres. Damages to crops and pasture are estimated to be \$31,200 per year.

The entire area of about 40,000 acres contains serious hazards to urban development. Present use of the flood plain is hay and pasture with little acreage of cropland due to frequent inundations. Higher net incomes would be attainable under flood free conditions. In addition to crop and pasture flood damage, damages to homes, roads and other facilities are prevalent.

Black Creek is a typical tributary to Tonawanda Creek which is affected both by floodwater from Tonawanda Creek and by its inadequate capacity to carry runoff from its own drainage area. Approximately 4,700 acres can be benefited if flooding is controlled and adequate drainage outlets are provided. A Watershed Investigation Report of Black Creek is included in the Appendix B.

## ELLCOTT CREEK

Floodwater damages in this study area are not extensive and the flood plain is in relatively low intensity land use within the 100-year frequency limits, (Appendix B, Figure B-2).

An estimated 1,500 acres of agricultural lands along Ellicott Creek are inundated on a frequency which inhibits a more intensive land use and cropping.

## MURDER CREEK

Flood and inadequate drainage conditions have long been a problem in this area. There are 1,050 acres which are damaged by both floodwater and drainage restrictions.

Agricultural land on the flood plain is estimated at 800 acres. This is considered the magnitude of inundations most likely to occur each year. Few crops are in evidence near the stream which is bordered mainly by pasture, forest or idle land. The major area of damage lies between the villages of Corfu and Akron. The damage estimate on a yearly basis is \$5,500 to agricultural interests. In the flood plain area, ponding and overbank flow have retarded the full development of the land's agricultural potential.

In addition to agricultural damages, there are residential, bridge, and road damages attributable to flooding especially through the village of Akron. Residential damages, the inundations of cellars, lawns, garages, etc., are estimated at \$2,300 per year. Other damages such as road washout and scoured bridge abutments exist and are estimated at \$1,200 per year. Consequently, the total annual damage within the Murder Creek drainage area is approximately \$9,000 (see Appendix B).

## CATTARAUGUS CREEK

Floodwater damage on Cattaraugus Creek was not studied by USDA during this investigation, but certain facts are known.

Flood plain areas subject to frequent inundations from the creek are scattered and relatively minor in size to the drainage areas concerned. The flood plain is estimated at 3,760 acres from the mouth of the creek to the smaller headwaters. The large flood plain area near the mouth is on the Cattaraugus Indian Reservation. A majority of the cropland in the area is leased from the Indians and is on the higher bottomland area. This land is not subject to serious frequent inundations.

During the study of irrigation projects, the average annual floodwater damage on Thatcher Brook in Gowanda was estimated to be \$4,420.

## IRRIGATION

Irrigated acreage is estimated to increase from the present 4,700 acres to 44,700 acres by the year 2000. Crops likely to be irrigated are fruits, vegetables, and potatoes.

The more than ninefold projected increase in acreage will require great amounts of water. At the same time, irrigation water will be important for increasing yields and meeting processors demands for improved quality and product uniformity.

The location of the land presently irrigated is summarized in Table 5.3. Appendix C, Table C.10 and Figure C.1 give detailed information concerning land presently irrigated. Nearly all of the acreage irrigated is located in Erie County. Crops commonly irrigated are: fresh market and processing vegetables, potatoes, and some small fruits.

The Erie-Niagara Basin is similar to most areas of the humid northeast in that rainfall patterns, amounts, distribution, and time of occurrence are erratic. In most years, there are usually several periods during the growing season when rainfall is not sufficient to replenish soil moisture for optimum crop growth. Consequently, it is during these periods of shortages that supplemental irrigation is needed.

Furthermore, not all rainfall is effective. Effective rainfall is that part of the total rainfall which does not run off, but enters the soil and is available for plant use.

Table 5.3. Acreage Estimates and Location of Land Presently Irrigated By Watersheds, 1967.

WS No.	:Estimated : :Acres Irr.:	Source of Water	: : Type of Crop or Area
1	740	Ponds, Creeks Co. Water System	Process, Market, Potatoes Nursery, Golf Course, Snow
44	360	Ponds, Creeks	Process, Market, Potatoes, Golf Course
56	895	Wells, Ponds, Creeks	Market, Potatoes
57	420	Ponds, Creeks, Co. Water System	Market, Golf Course
72	1265	Ponds, Wells, Creeks	Market, Process, Nursery
115	130	Ponds, Creeks	Market, Golf Course
148	None	None	None
203	345	Lake Erie, Ponds	Golf Course, Market
238	400	Creeks, Ponds	Process
239	95	Ponds	Golf Course
240	None	None	None
241	75	Ponds, Municipal	Golf Course
244	None	None	None
245	None	None	None
TOTAL	4725	-	-

Most of the streamflow from rainfall and snowmelt runoff occurs during the nongrowing season. Some streams are dry and others are at their lowest discharge during portions of the growing season, thus limiting the amount of irrigation which can be done by direct withdrawal from streamflow.

As irrigated crop acreage increases, water in addition to that now used will be required.

Irrigation water is now being obtained mostly from streams, wells, and ponds. However, streams often have insufficient flow during the irrigation period. Too, wells often do not provide an adequate supply during the season or the water is of such poor quality it cannot be used for irrigation. And, ponds usually have inadequate capacity and lack the ability to be recharged by ground water.



SUPPLEMENTAL IRRIGATION IS NEEDED FOR GOOD CROP PRODUCTION

## AGRICULTURAL DRAINAGE



POORLY DRAINED CROPLAND

There are about 91,000 acres of cropland in the Basin that need and can be benefited by drainage. Of the total, about 48,000 acres are in the Allegheny Plateau area, and 43,000 acres are located in the Ontario Plain and Eden Valley sections.

Figure 5.3 shows the type of drainage improvement needed within the Basin. Most of the areas in the Allegheny Plateau are small and occur generally on one farm. Suitable outlets are available or easy to construct because of the sloping topography.

The drainage problem in the Ontario Plain is more acute, and some aspects of the problem are quite different. Several problem areas are large and contiguous, topography is nearly level, and outlets are lacking. Construction of these drainage systems requires group action by many landowners. Flooding is an added problem in some areas.

A major portion of the Ontario Plain area representing about 28,000 acres of cropland, requires on-farm and small group action. The groups should vary from two to seven landowners. The remaining 15,000 acres of cropland in the Ontario Plain demands group action to solve the drainage problem. The most critical areas are located in the following watersheds: Tonawanda Creek, Murder Creek, Ransom Creek, Mud Creek, and the lower portion of Ellicott Creek.



At the present time, farmers in these areas have adjusted to these problems through less intensive farming and land use. Much of the land is in hay and pasture. In recent years, a considerable amount of land has been taken out of farming and is idle. However, it should be noted that the area has a high potential for agricultural use and production if the drainage problem is eliminated or reduced.

Black Creek is a typical example of areas in the Lower Tonawanda flood plain which, if provided with adequate drainage and flood protection, could have a great economic agricultural potential. Areas like Black Creek make up a total of about 40,000 acres in the Lower Tonawanda area.

Several areas with drainage problems in Erie, Niagara, and Genesee Counties are being subjected to urban development. This creates problems when residential construction occurs on the areas where drainage and flooding problems are evident. Fill must be used to build up the foundations so that floodwater damages and drainage problems can be reduced. This practice increases construction costs and when a basement is present, drainage damage will persist. Septic tanks in the poorly drained areas will not function properly causing inconvenience as well as creating a health hazard.

## WATERSHED PROTECTION AND MANAGEMENT

Land resources will have to be properly protected and managed if they are to maintain their productive capacities. More intensive use of land resources will create pressures in the future. These pressures involve all managerial aspects from technology to proper use and application of good conservation measures.

Land resource problems are soil erosion, excess water and unfavorable soil conditions. These problems occur on 180,100 acres of cropland, 86,800 acres of pasture land and 147,200 acres of forest land.

## CROP AND PASTURE LAND

Resource problems on 180,100 acres of cropland are shown by county in Table 5.4. Drainage is the dominant problem on 91,000 acres, erosion on 86,900 acres, and shallow and droughty soils, which yield poor crops, on 2,200 acres.

Table 5.4. Resource Problems on Cropland 1/.

County	Problems			Total Acres
	Erosion	Excess Water	Shallow and Droughty Soils	
Allegany	100	-	-	100
Cattaraugus	8,300	13,000	900	22,200
Chautauqua	600	100	-	700
Erie	34,800	27,600	600	63,000
Genesee	22,500	20,400	700	43,600
Niagara	1,500	18,100	-	19,600
Orleans	-	-	-	-
Wyoming	19,100	11,800	-	30,900
BASIN TOTALS	86,900	91,000	2,200	180,100

1/ Source: Adjusted 1958 Conservation Needs Inventory Data

Resource problems on pasture occur on 86,800 acres (Table 5.5). Two or more problems often occur on the same acre of pasture. Better land management to prevent overgrazing should be practiced on 7,400 acres while cover protection from erosion and excess water is necessary on 13,400 acres.

Table 5.5. Resource Problems on Pasture Land 2/.

County	Problems			Total Acres
	Inadequate: Cover	Overgrazing	Erosion and Excess Water	
Allegany	100	-	-	100
Cattaraugus	27,800	5,500	6,700	27,800
Chautauqua	200	-	-	200
Erie	31,300	1,000	500	31,300
Genesee	4,300	900	2,200	4,300
Niagara	2,100	-	1,500	2,100
Orleans	-	-	-	-
Wyoming	21,000	-	2,500	21,000
BASIN TOTALS	86,800	7,400	13,400	86,800

2/ Source: Adjusted 1958 Conservation Needs Inventory Data

## FOREST LAND

Potential resource problems occur on 147,200 acres of forest land in the basin. These problems are summarized in Table 5.6.

Table 5.6. Forest Land Problems.

Problems	Acres
Undesirable Stand Conditions	59,000
Preventing Improper Cutting Practices	51,000
Grazing	31,000
Understocked	4,000
Critical Erosion Areas	1,500
Eroding Skid Trails and Access Roads	700
TOTAL	147,200

A forest fire hazard exists on the entire 306,340 acres of forest land.

## EROSION AND SEDIMENTATION

The geologic process of erosion and its product, sediment, become problems when their occurrence conflicts with the interests and activities of man. The rate at which soils erode depends upon several factors some of which are: soil type, length and steepness of slope, land use, vegetal cover, past and present management, and the conservation practices installed.

Scouring of streambanks is one of the principal erosion problems. Soils scoured from streambanks go directly into the streams becoming a major contributor to the total sedimentation problem. Sheet erosion is severe in a few local areas where gullies are evident. Because of the large land area involved, the small amount of sediments generated from each acre by sheet erosion collectively combines to contribute from 100 to 1500 tons of sediment per square mile.

## STREAMBANK EROSION

Streambank erosion is the most significant type of erosion in the Basin. The 1956 Buffalo Creek bank stabilization project reduced erosion, and sediment deposition on Buffalo, Cayuga, and Cazenovia Creeks. The project

protects 35 miles of previously eroding banks and has reduced sediment delivery to Buffalo Harbor by nine percent which was accompanied by a 24 percent reduction in Harbor dredging 3/.

Streambank erosion occurs to some degree on most streams. Currently, 80 miles of raw streambanks are found in the Basin (Figure 5.4). The most common occurrences are at meanders or bends of the streams. Most streambank cutting on tributary streams occurs in small areas and damages mostly low value land. However, in the upper reaches, streams cut into high banks thus contributing significant amounts of sediments.



ACCELERATED STREAMBANK EROSION

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3/ Parsons, D. A.; Apmann, R. P.; and Decker, G. H.; *The Determination of Sediment Yields from Floodwater Sampling*

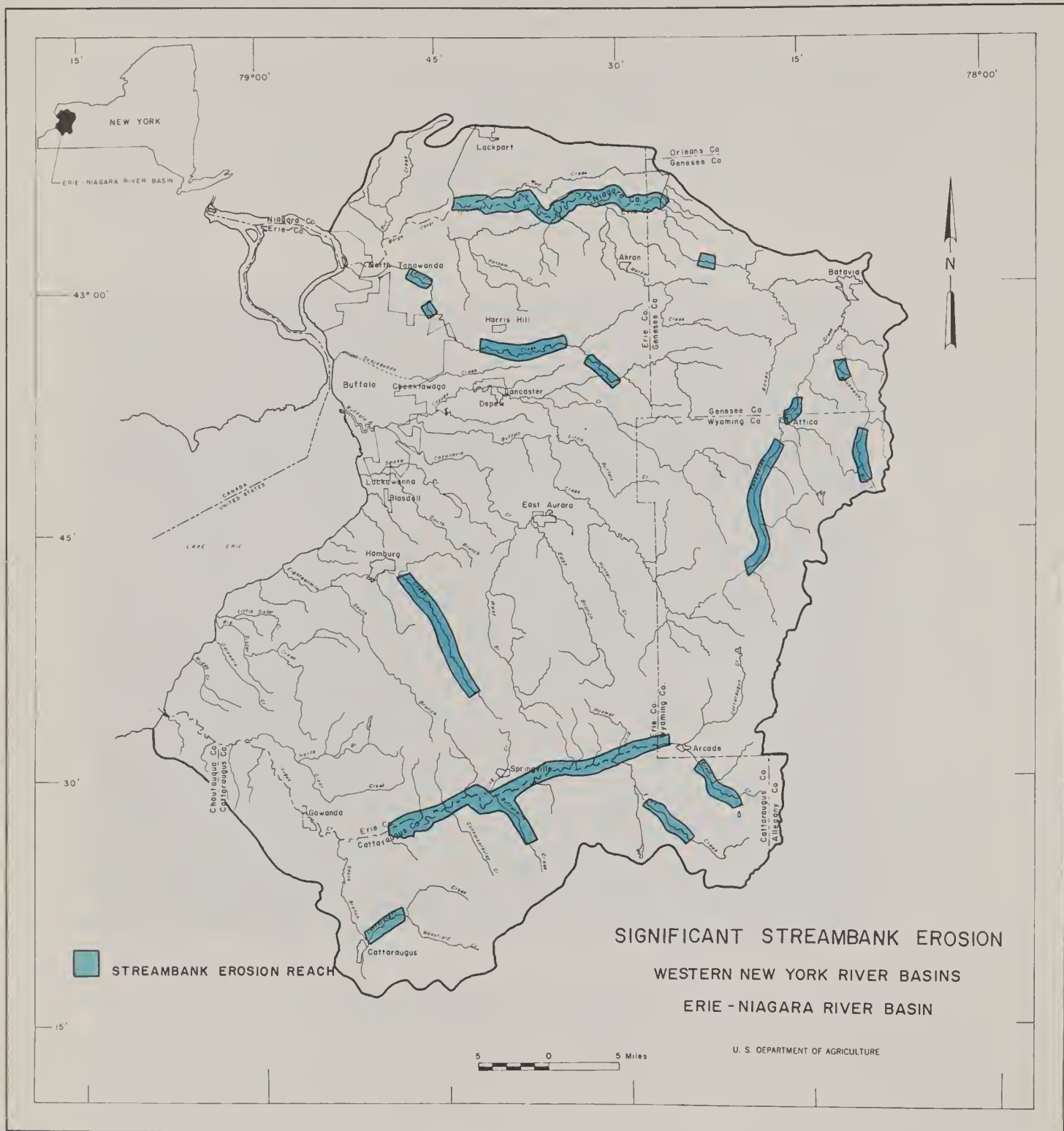


FIGURE 5.4

Significant streambank erosion is located in the following watersheds.

#### CATTARAUGUS CREEK

A very high erosion hazard exists in this watershed because of the extensive fine-grained lake-laid soils which are found in the area. Several tributary streams have significant occurrences of streambank erosion.

The main stem of Cattaraugus Creek from Arcade to below the confluence of Connoisaurauley Creek, a distance of 18 miles, is the worst area. Bank erosion is found 1 mile above and below the hamlet of Sandusky on Clear Creek, approximately 4 miles downstream from Elton on Elton Creek, on Buttermilk Creek 4 miles above its confluence with Cattaraugus Creek, and along a 3 mile stretch of the South Branch of Cattaraugus Creek between the hamlets of Otto and Cattaraugus.

#### EIGHTEENMILE CREEK

Streambank erosion occurs to some degree in several areas, but is considered critical on Eighteenmile Creek from Boston to the city of Hamburg, a distance of 10 miles.

#### ELLCOTT CREEK

Significant streambank erosion is scattered for about 8 miles along Ellicott Creek from Alden to about Ransom Road, town of Lancaster.

#### UPPER TONAWANDA CREEK

Tonawanda Creek has approximately 12 miles of streambank erosion upstream from **Johnsburg** to Attica.

Little Tonawanda Creek has 3 miles of eroding banks.

#### MIDDLE AND LOWER TONAWANDA CREEK

Critical streambank erosion is occurring along the entire length of the stream from the Tonawanda Indian Reservation to Pendleton.

#### SHEET EROSION

Sheet erosion is the most common type of erosion and is found throughout the Basin. Soil survey maps show that almost all sheet erosion is moderate in degree except for a few small local areas which have sheet erosion designated as severe.

One of the main factors in the amount of sheet erosion which occurs is land use. Where intensive cropping patterns are improperly used, where cover conditions are poor, or where soil is undergoing extensive disturbance during a change in use such as urban development, erosion is more severe.

Soil losses through sheet erosion range from 100 to 1,500 tons per square mile. The erosion hazard is greatest in the Allegheny Plateau area because of topography. Serious hazard areas have a combination of easily erodible lake-laid or uniform, silty glacial till soils and steep slopes. Such hazard areas occur along Cattaraugus Creek and sections of Eighteen-mile, Cazenovia, and Buffalo Creeks. These are the dominant areas of active sheet erosion.

## GULLY EROSION

Sheet erosion when uncontrolled progresses through stages of rill erosion into gully erosion. There are very few areas of gully erosion in the Basin because proper cultural practices and protection by conservation practices are preventing sheet erosion from progressing into gully erosion.

## EROSION FROM URBAN AND ROAD DEVELOPMENT

Several areas are undergoing extensive soil disturbances caused by urban development and highway construction. These areas have a high erosion hazard and are areas of active erosion. Reports and studies reveal soil losses in excess of 50 tons per acre are found in areas of construction. This can be a real problem when the construction area is adjacent to a stream.

## SEDIMENT DAMAGE

Sediment damage on agricultural land is slight. Normal sediments deposited on the flood plain are silts and sands only a fraction of an inch thick. Such deposition is damaging when it occurs in homes and on furnishings. Heavy concentrations of sediment in the streams pollute the water, damage fish habitat, and reduces the use of the stream for swimming, water supply, and other uses.

Only a small amount of infertile overwash is deposited on cropland. Local occurrences have been observed where streams emerge from steep gradient areas in the Allegheny Plateau.

The most significant damage to agricultural land is the loss of fertile alluvium when streams cut new channels. These fine alluvial soils are replaced by infertile cobbly riverwash which cannot be cultivated.

If erosion is kept at a minimum the damage caused by sedimentation will not be significant.

## POLLUTION

Presently there are approximately 135 miles of polluted streams in the Basin (Figure 5.1). Water quality of Lake Erie has deteriorated due in part to pollutants entering the lake from the Basin. Raw or inadequately treated wastes discharged by industries and municipalities and sediments are the principal sources of pollution. Types of wastes discharge into streams include synthetic dyes, oil, phenolics, cyanide, ammonium and solids. In addition, pesticides and fertilizers have taken on more importance and are causes of much concern.

### SOURCES

#### SEDIMENTS

Upland soil loss and bank erosion along the streams are the principal sources of sediment pollutants. These sources have been discussed in the preceding section on Erosion and Sediment.

#### PESTICIDES

Pesticides are needed for the economic production of food and fiber. The use of these chemical tools has made a tremendous contribution to man's health and welfare over the past 25 years.

Their use presents a potential for contamination of the environment. Unfortunately, in some instances they have been abused and misused without due consideration to their impact on other organisms.

#### FERTILIZERS

Pollution from fertilizers is not thought to be a problem of great magnitude. Fertilizers can contribute to stream pollution by adding nutrients to surface waters by runoff, erosion or percolation. Nitrogen and phosphorous compounds are of major concern. When present in streams, they contribute to the growth of various algae forms. Algae can be a nuisance by contributing foul odors and taste to the water and depleting the dissolved oxygen supply.

## LOCATIONS

Numerous streams are polluted by a variety of elements discharged into streams. Sewage and industrial waste treatment facilities are inadequate and low stream flows are significant problems. Figure 5.1 shows the location of the polluted stream reaches described below. More detailed information may be found in the publication entitled *Report on Pollution of Lake Erie and Its Tributaries, Part 3 - New York and Pennsylvania Sources*, U. S. Department of Health, Education and Welfare.

### BUFFALO CREEK

For the last 5 miles of its length, Buffalo Creek is known as the Buffalo River. This grossly polluted river serves as a source of water supply and waste transport for some of the major industries which line the banks.

Buffalo Creek is polluted for the 4 miles between the hamlets of Blossom and Elma.

Cayuga Creek is polluted in two reaches. A nine-mile reach is located between the city of Lancaster and its confluence with the Buffalo River. A second reach, six miles in length, is located between the hamlets of Cowlesville and West Alden.

East Branch of Cazenovia Creek is polluted at Holland and downstream for two miles. The stream has pollution upstream and downstream of East Aurora for a total distance of five miles.

West Branch Cazenovia Creek is polluted for six miles between Glenwood and West Falls.

### CATTARAUGUS CREEK

Main stem Cattaraugus Creek has significant pollution in two reaches. A 15-mile reach is located from Gowanda to Lake Erie. The second reach is 3 miles long and is just below Arcade.

Clear Creek has one mile of pollution at and below the hamlet of Sandusky. Elton Creek is polluted from two miles just above and below Delevan. Spring Brook has pollution on a reach two miles long from Springville to its confluence with Cattaraugus Creek. Hosmer Creek has pollution from Sardinia to its confluence with Cattaraugus Creek. Connoisaurauley Creek is polluted from Ashford Hollow downstream for a distance of one mile.

South Branch of Cattaraugus Creek has two polluted reaches. The first is from East Otto downstream for a distance of 3 miles. The second is from Otto downstream for a distance of 2 miles.

## EIGHTEENMILE CREEK

Eighteenmile Creek has 10 miles of pollution which extends from the hamlet of Boston to its confluence with the South Branch of Eighteenmile Creek.

## ELLICOTT CREEK

The longest reach of polluted stream in the Basin is located between Alden and North Tonawanda on Ellicott Creek.

## BIG SISTER CREEK

Big Sister Creek is polluted for 14 miles from North Collins to its confluence with Lake Erie.

## SMOKES CREEK

Smokes Creek is polluted from its confluence with Lake Erie upstream for 2 miles.

## UPPER TONAWANDA CREEK

Upper Tonawanda Creek has a 5 mile reach polluted between the city of Batavia and East Pembroke.

## LOWER TONAWANDA CREEK

Lower Tonawanda Creek is polluted between Pendelton and Martinsville, a distance of 10 miles.

## SCAJAQUADA CREEK

Scajaquada Creek is polluted downstream from the city of Depew for a distance of 3 miles.

## EFFECTS

In addition to killing fish, wildlife and other living organisms and the extreme hazard to humans, water pollution also detracts from the natural scenic beauty and limits recreational use. In several locations, especially along Lake Erie, recreational facilities had to be abandoned because of water pollution. In addition to pollution limiting water for recreational use, it reduces the value of property adjacent to it.

## WATER QUALITY CONTROL

There is a great need to drastically reduce this ever-increasing problem which diminishes the quality of surface waters for consumptive uses, recreation, fishing and aesthetic values. The need for water quality control is described in the following quotation from the Water Resources Commission report *Developing and Managing the Water Resources of New York State*.

*Water quality management involves consideration of all forms of pollution of streams and lakes. Historically the principal concern has been with discharge of biologically degradable material and its effect on dissolved oxygen available in the waterway. Attention has also been focused on the discharge of toxic industrial wastes. More recently, the less obvious pollutants, such as nitrogen and phosphates which affect algae growths, have gained prominence along with other dissolved mineral salts and heat pollution from cooling water discharges.*

## WATER SUPPLY

### MUNICIPAL AND INDUSTRIAL WATER SUPPLY

The need for a central water system for rural communities with populations under 5,500 (the limit of USDA study authority) was surveyed by the Farmers Home Administration. The survey shows three villages (107 households) in Cattaraugus County, eight villages (275) and the Tonawanda Indian Reservation (100) in Genesee County and seven villages (772) in Wyoming County have water of inferior quality. In addition, Dayton (90), Perrysburg (330), and Versailles (73) in Cattaraugus County and Colden (140) in Erie County were found to have a water shortage.

Also surveyed were communities with central water systems. This survey points up the need for an extension and an improvement of the system in three communities. Machias and Lime Lake need to service 43 households and four commercial establishments. Yorkshire needs to service 25 households and the Eden system needs to service 200 households.

Other surveys indicate water supplies are inadequate or not fully developed at Akron, Arcade, Darien City, Farnham, Gowanda, Sandusky and West Valley.

SMSA areas were not surveyed under the FHA program. Another agency is responsible for the survey in this area. Moreover, other agencies are responsible for studies of communities with more than 5,500 population. They have reported to the water supply task group that the city of Batavia needs additional water.

## RURAL DOMESTIC AND LIVESTOCK WATER SUPPLY

Agricultural water requirements include the use of water for farm residences, all types of livestock production and the spraying of fungicides and insecticides on crops. Table 5.7 presents the projection of water requirements for various rural consumptive uses.

The major source of supply to meet the present water demands of the on-farm and rural non-farm domestic consumers is ground water.

A review of the agricultural water use picture for the Erie-Niagara Basin indicates that there are no large or extensive areas which might be classified as chronic deficit areas. It is concluded that the supply is in line with the demand and will continue as such. There are minor exceptions and where these exist a look at the agricultural potential should be made to properly evaluate the supply and demand balance.

An area along Lake Erie from the village of Blaisdell southward to Brant-Evans township line and bordered on the east by the New York State Thruway has very limited perennial water supplies available from individual wells. This area is not an extensive agricultural producer and it is unlikely that large quantities of supplemental water would be required in the future.

Some farmers in the Cayuga Creek watershed in Wyoming County have reported minor water problems in terms of inadequate supply. These areas are scattered.

Another area in Wyoming County of short supply lies south of the village of Attica, along Exchange Street to South Attica and Dutch Flats. Ground water sources are inadequate to meet present demands and the majority of farmers are forced to haul water from Attica. The 4-H camp near Varysburg had water shortages during the 1965 summer and inadequate supplies might deter future development of the camp.

## RECREATION

An ever-increasing demand for recreational facilities, especially those providing swimming, boating and picnicking, has been experienced in most areas. As a result, many of the existing facilities are overcrowded.

This problem will become greater in magnitude in the future when significant population increases occur. The current Basin population of 1.2 million is expected to increase by 80 percent in the next 50 years to 2.1 million. This increase coupled with water pollution reducing the number of surface acres available, emphasizes the need for more water-based recreational facilities.

Day use attendance at all New York State parks approached 8 million in 1964, a 64 percent increase over 1959. Estimated county and municipal park attendance show even greater increases.

Table 5.7. Water Requirements for Various Consumptive Uses, 1968.

Type of User or Product	Projections				
	1960	1980	1990	2000	2010
	Million Gallons				
Milk	802.1	801.0	894.0	1,004.6	1,146.6
Beef and veal	207.0	270.0	315.0	369.0	405.0
Lamb and mutton	4.8	3.8	4.8	4.8	4.8
Pork	27.4	16.6	14.1	17.4	13.3
Chickens	0.1	0.1	0.1	0.1	0.1
Eggs	15.0	10.9	10.9	10.7	10.0
Fruit 4/	23.6	24.6	24.6	24.6	24.6
Domestic					
Rural, nonfarm	2,664.9	5,691.8	9,460.8	13,728.0	18,911.7
Rural, farm	331.6	371.8	456.8	511.1	495.1
TOTAL	4,076.5	7,190.6	11,181.1	14,670.3	21,011.2
					27,182.2

4/ Assumes water use does not include irrigation.

Increases in demands for various recreational activities in the Buffalo-Rochester Planning Region are as follows:

1. Swimming - could increase by 60-70 percent, based on larger resident population.
2. Picnicking - will increase at a moderate rate.
3. Boating - the estimated ratio of registered boats to population is the lowest in the state and the growth rate in the Basin is expected to exceed other inland regions.
4. Fishing - participation could increase by 50 percent. Currently 29 percent of the state's total resident licenses are sold in this region.
5. Hunting - participation currently exceeds all other regions and is about 35 percent of the state's total. Hunting demands should show a moderate increase.

## FISH AND WILDLIFE



MORE FISHERIES HABITAT SUCH AS THIS IS NEEDED

Fishing and hunting are major recreational activities in the Basin. The amount of habitat available for wildlife species includes 670,000 acres for deer and more than one million acres for small game. Fisheries habitat includes numerous creeks and brooks as well as a few small lakes and ponds.

Both wildlife and fisheries habitat are being reduced by urban expansion, posting of private lands, and water pollution. The New York State Division of Fish and Wildlife studied the wildlife and fisheries problem in the Erie-Niagara Basin and determined the following:

Wildlife problems:

1. Too much posted land.
2. Habitat for deer and small game species is being reduced.
3. Maintain wildlife population at maximum levels compatible with existing land uses.
4. Not enough public land.
5. Techniques in regulating harvest of wildlife have not changed.
6. Herbicides and pesticides are affecting native wildlife populations.
7. News media is not doing enough with conservation education programs.

Fisheries problems:

1. Not enough access for trout and warm-water fishing on both streams and lakes.
2. Pollution is reducing the number of fisheries.
3. Stream habitat is not being preserved or improved.
4. A shortage of lakes and reservoirs which provide more trout and warm water fisheries.
5. A lack of flow augmentations in volumes and temperatures adequate for downstream fisheries.

# EXISTING WATER AND RELATED LAND RESOURCE PROJECTS AND PROGRAMS

## SOIL CONSERVATION SERVICE

### PUBLIC LAW - 46

This law established the Soil Conservation Service (SCS) in April 1935, and made SCS responsible for developing and carrying out a national program of conservation and development of land and water resources.

The Service has an objective of integrating the planning of land use and the installation of conservation treatment in harmony with the capability and needs of the land. To accomplish this, SCS employs scientists and technologists from many disciplines to diagnose land and water resource problems and prescribe successful treatment and use.

Most of the on-the-land SCS assistance to landowners is channeled through local soil and water conservation districts. Some of the conservation practices the SCS has offered technical assistance on in the Basin include:

Contour farming	Stripcropping
Cover and green manure crops	Terraces
Crop residues	Bedding
Diversions	Open ditches
Grass waterways	Land grading
Ditch bank seeding	Tile drains
Streambank protection	

These measures have solved numerous erosion, sediment, and drainage problems in the Basin which has resulted in increased agricultural yields, and reduction in crop damage. There are still many areas in the Basin having land and water resource problems and additional work to apply more conservation practices must be undertaken in the future.

The Service also is conducting a soil survey of the Basin in cooperation with the Cornell University Agricultural Experiment Station as a part of the National Cooperative Soil Survey. Maps and soils information can be used by farmers and other landowners, agricultural advisors, foresters, biologists, community planners, engineers and builders, bankers, and local governmental agencies to solve land resource problems. Soil surveys have been completed for Allegany, Genesee, Niagara, and Wyoming Counties. Counties with surveys in progress are Cattaraugus, Chautauqua, Erie and Orleans.

## PUBLIC LAW 566 PROJECTS

Under this law, technical and financial assistance to state and local organizations is provided for planning, designing and installing watershed works of improvement. Cost-sharing is provided for flood prevention, irrigation, drainage, sedimentation control, fish and wildlife developments, and public recreation. Long term credit can be obtained by local interests for their share of the costs. The Soil Conservation Service of the United States Department of Agriculture administers this program which provides a means of solving watershed protection and flood prevention problems which cannot adequately be met by other going programs.

Currently, the Erie-Niagara Basin does not have a completed PL-566 project. An application has been received for a PL-566 project in Upper Tonawanda Creek located in Genesee and Wyoming counties. This watershed has been investigated and the results are discussed in the "Opportunities for Development and Impact of USDA Programs" section of this report.

The Forest Service is responsible for the forestry phase of PL-566 watershed projects and for soil and water conservation applicable to lands used for forestry purposes.

## FLOOD CONTROL ACT OF 1944

Within the Basin is the Buffalo Creek Flood Prevention Project, one of the original eleven authorized flood prevention projects under the Flood Control Act of 1944. The construction work proposed for Buffalo Creek has been completed, and the project's works of improvement are being maintained by the Erie and Wyoming Soil and Water Conservation Districts.

## RESOURCE CONSERVATION AND DEVELOPMENT (RC&D) PROJECTS

In the southern portion of the Basin, Cattaraugus, Chautauqua and Allegany counties have been designated as the Seneca Trails Resource Conservation and Development Project. The project plan has been published and over 150 project measures have been proposed, 17 of which are in the Erie-Niagara Basin.

Ten project measures in the Basin are directed toward solving recreation problems and the remaining seven measures are divided among other uses. These recreation measures will assist in meeting some of the recreation needs previously described in this report. The RC&D program can assist in financing some of the recreation sites proposed in the early action program for the Basin. As knowledge and understanding develops, the program is flexible enough so that it can be adapted for the implementation of additional measures.

The Soil Conservation Service has leadership in this program. Assistance is provided where acceleration of going programs of resource conservation, development and utilization will increase economic opportunities for local people.

Technical help is available on flood, sediment, and erosion problems as well as advice on ground cover, tree and shrub varieties, necessary for beautification and wildlife projects. Financial assistance is available as well as loans on a limited basis.

## FOREST SERVICE

### COOPERATIVE FOREST FIRE CONTROL (C-M LAW, SECTION 2)

Professional and financial assistance is provided to states for fire protection on nonfederal forest land. States administer the protection programs and are reimbursed from federal funds up to 50 percent of expenditures. Federal participation includes services such as assisting in training personnel, development and procurement of better fire equipment and tools, radio development and use, preparation of fire plans, assisting in application of new developments in forest fire research, and direction of the nationwide forest fire prevention program. Continued forest fire protection will be needed on more than 306,000 acres of forest land to maintain and improve forest hydrologic conditions and to assure continued improvement of forest resources.

### FOREST MANAGEMENT (COOPERATIVE FOREST MANAGEMENT ACT OF 1950)

States are provided financial and professional assistance to assist private forest landowners in practicing multiple-use forest management. The cooperative forest management program is administered by the state and reimbursed from federal funds on a cost-sharing basis. Private forest landowners are provided on-the-ground technical assistance by professional foresters employed by the state. The following has been accomplished by the New York State Department of Environmental Conservation under the Cooperative Forest Management Program for the period 1958 to 1967 in the Erie-Niagara Basin:

Woodland owner assistance	57,569 acres
Management plans	11,954 acres
Timber marked	5,045 acres
Timber harvested	2,811 acres
Timber stand improvement	1,646 acres
Planting and seeding	
(reforestation)	3,789 acres
Grazing, protection	1,167 acres

States may also receive financial and professional assistance for sawmill operators and other processors of forest products for improved logging, processing and manufacturing techniques, marketing information, and safety.

### PUBLIC LAW 566 PROJECTS

The Forest Service is responsible for the forestry phase of PL-566 watershed projects and for soil and water conservation applicable to lands used for forestry purposes. This includes the planning and installation of forest land treatment measures on privately-owned forest lands. These

measures are to improve forest hydrologic conditions and to achieve soil and water conservation of forest lands in order to bring about the greatest reduction in flood, erosion and sediment damages.

Professional and financial assistance is provided to the state by the Forest Service. The on-the-ground technical assistance to private landowners is furnished by the state forester on a cost-sharing basis with the U. S. Forest Service. Forest Service participation requires close cooperation with the Soil Conservation Service, state agencies and local organizations in developing and carrying out watershed work plans.

#### OTHER PROGRAMS

Forest landowners may qualify for federal cost-sharing through the Agricultural Conservation Program for approved practices.

Research programs in watershed management are being carried out by the Forest Service Experiment Station in cooperation with state or small private institutions under the McSweeney-McNary Act of 1928.

#### COOPERATIVE EXTENSION SERVICE

This agency conducts educational programs in several broad areas; two of these being the agricultural and forestry production and marketing program, and the community resource development program.

The agricultural and forestry production and marketing program provides technical assistance to individuals and firms in utilizing new technology resulting from research. The community resource development program provides educational, organizational and technical assistance to communities in developing their resources.

The 4-H Youth Development program is also administered by this agency which provides guidance and development for youth in several areas.

Through these programs individuals in the Basin can obtain current information and assistance to aid in solving land and water resource management problems.

#### AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

The Agricultural Stabilization and Conservation Service administers several United States Department of Agriculture programs in the Basin area. One of these, the Agricultural Conservation Program, provides cost-sharing assistance to agricultural producers who undertake soil, water, forestry, and wildlife conservation practices on farmlands currently in agricultural production. The cost for such practices is shared between the federal

government and the agricultural producer.

Technical assistance for ACP practices is rendered by the Soil Conservation Service, Extension Service, and the New York State Department of Environmental Conservation in cooperation with the Forest Service.

The Agricultural Conservation Program can serve as a valuable tool in solving the erosion and sediment problems and other resource needs in the Basin through the establishment of conservation practices.

## FARMERS HOME ADMINISTRATION

This United States Department of Agriculture agency administers many programs available to landowners and rural communities in the Basin. Among the programs are:

- Emergency Loans
- Farm Ownership Loans
- Financial Assistance to Small  
  Towns and Rural Groups
- Loans and Grants for Farm Labor  
  Housing
- Loans for Forestry Purposes
- Loans for Recreational Purposes
- Loans to Rural Families with  
  Small Incomes
- Operating Loans
- Rental Housing
- Rural Housing Loans
- Rural Renewal Loans

Of particular importance in the Basin are farm ownership loans, financial assistance to small towns and rural groups, and loans for recreational purposes. Farm ownership loans are used for a variety of purposes, including providing basic soil treatment and land conservation measures as well as providing necessary water and water facilities. Also of significance is the program which provides financial assistance to small towns and rural groups, makes loans and grants to public and nonprofit organizations primarily serving rural areas to plan and develop domestic water supply and waste disposal systems. Loans for recreational purposes program provides funds to operators or managers of family farms for the purpose of developing land and water resources; repair and construction of buildings; purchase land, equipment, and related recreational items; and pay necessary operating expenses.

These programs can assist financially in solving major problems of sediment and erosion control, as well as providing municipal water, waste disposal systems, and recreational facilities.

## SOIL AND WATER CONSERVATION DISTRICTS

Soil and water conservation districts are legally constituted units or instrumentalities of state government created to administer soil and water conservation work within their boundaries. They sponsor or co-sponsor most watershed protection and flood prevention projects and resource conservation and development projects. By virtue of their broad activities, districts have an important role in the development of rural areas.

There are eight soil and water conservation districts partially or wholly in the Basin area. These are the Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans, and Wyoming districts.

These districts focus attention on land and water problems, develop annual and long-range programs designed to solve the problems, and enlist all the appropriate, available help from public and private sources that will contribute to the accomplishment of the district's goals. They also participate in the development of the agricultural conservation programs in each county.



LAND TREATMENT ON A WYOMING COUNTY FARM

Adoption of conservation practices by landowners through the soil and water conservation districts is a major step in reducing erosion, sediment and flood damage in the Basin. Major practices now on the land include:

Conservation Cropping Systems	170,000 acres
Contour Farming	19,500 acres
Diversions	300 miles
Drainage Mains and Laterals	180 miles
Pasture and Hayland Planting	71,500 acres
Ponds	2,100 (number)
Streambank Protection	110 miles
Stripcropping	16,000 acres
Tile Drains	790 miles

Districts have provided additional funds for accelerating the soil survey field work. Districts are also providing funds for soil interpretations - mainly for urban uses.



## WATER AND RELATED LAND RESOURCE DEVELOPMENT POTENTIAL

Within any basin there are potential developments which must be recognized and measured to evaluate their capacity to satisfy identified water and related land resource problems and needs. This chapter identifies the water and related land resource development potentials in upstream areas and those which primarily affect the rural areas. Additional studies of large impoundment sites are being undertaken by the Corps of Engineers and the New York State Department of Environmental Conservation, Division of Water Resources.

Available cropland is expected to decrease from the present 439,700 acres to 204,500 acres by the year 2020. This increases the importance of proper land use development. There are about 136,000 acres which have high development potential for irrigated agriculture.

An inventory of potential upstream water impoundment sites for surface water supply resulted in the identification of 78 sites supplying over 105,300 acre-feet of beneficial storage and over 6,000 acres of pool area, at a cost of about \$33.7 million. These sites have the potential to meet needs for flood prevention, irrigation, recreation, low flow augmentation, municipal and industrial water supply, and fish and wildlife.

Ground water is a definite resource potential but the amount is not evenly distributed and is subject to a great deal of variation within short distances. Additional study is needed to more closely define ground water potential at specific locations.

About 92 miles of channel improvement could provide flood control and drainage improvement for over 40,000 acres of primarily agricultural land. The total cost would be in excess of \$7 million.

About 40,000 acres of Lower Tonawanda Creek area could be provided flood protection and drainage with about 90 miles of tributary channel improvement.

The village of East Aurora could also be provided flood protection through the construction of a diversion system.

Present irrigation water supplies plus an additional 6,400 acre-feet from 13 potential upstream irrigation sites can irrigate about 11,000 acres annually.

### AVAILABILITY OF LAND FOR POTENTIAL DEVELOPMENT

The method of projecting the availability of cropland is based upon unpublished information compiled by the New York State College of Agriculture. 1/

1/ Nobe, K.C.; E.E. Hardy; and H.E. Conklin;

*The Extent and Intensity of Farming in Western New York State*

This information covered: (1) numbers of farms grouped into three classes according to their intensity of land use; (2) survey data covering the cropland on three classes of farms; (3) estimates of how long farms in the three classes would continue in production and how much of the land on the farms dropping out would be used by those remaining.

This projection was developed specifically as a means of distributing cropland in each county among the Basin's watersheds. This was possible because the classified farms were individually located on the maps. The projections developed by this method are presented in Table 7.1. Cropland projected by this method is probably more realistic and more consistent with land requirements to meet production needs.

Table 7.1 Estimate of Cropland in Portions of Counties.

County	:	:	Projections								
	1958	:	1980	:	1990	:	2000	:	2010	:	2020
(Acres)											
Allegany	900		600		500		400		400		300
Cattaraugus	63,800		47,500		42,000		38,700		35,700		32,200
Chautauqua	2,400		2,100		2,000		1,900		1,800		1,800
Erie	171,000		111,000		92,200		84,400		77,000		68,700
Genesee	82,200		63,700		57,200		53,300		49,600		45,600
Niagara	46,000		28,600		22,800		20,000		17,000		14,100
Wyoming	73,400		58,300		52,800		49,000		45,700		41,800
BASIN TOTAL	439,700		311,800		269,500		247,700		227,200		204,500

There is considerable land which has a high development potential for irrigated agriculture. The general distribution of about 136,000 acres of irrigable land is shown in Figure 7.1. These lands are made up of soils of sufficient depth on level to gentle slopes, and with none to only minor soil limitation, so that their use for irrigated agriculture would be highly feasible.

Delineated areas near the Tonawanda Creek in Erie and Niagara counties have good irrigation possibilities, but will require group drainage projects to reach full potential.

Appendix C contains more detailed data on irrigation potential and study procedures, and evaluates seven recommended irrigation projects in the Basin.



## IMPOUNDMENTS



MULTIPURPOSE IMPOUNDMENT

An inventory of upstream water impoundment sites was made to determine the capability of the Basin to meet present and projected needs from this source. Tentative locations were selected for 170 structures through a study of USGS topographic maps. Thirty-seven of the sites were selected by the New York State Department of Environmental Conservation, Division of Water Resources and 133 locations were selected by the Soil Conservation Service. This was followed by a field reconnaissance of each site.

Seventy-eight of the sites were appraised as having the best potential to meet flood control, irrigation, recreation, and fish and wildlife needs. These 78 sites would provide a total beneficial storage capacity of over 105,300 acre-feet, would have a total surface area of 6,030 acres, and would cost an estimated \$33.7 million. Data on the number of potential sites, storage capacity, surface area and costs by watershed is presented in Table 7.2.

Table 7.2 Potential Sites, Storage Capacity, Surface Area and Total Installation Costs by Watersheds.

Watershed	: : No. : of : Sites	: : Beneficial : Storage 2/ : (Ac.Ft.)	: Beneficial: : Surface : Area : (Acres)	: Total : Installation : Cost : (\$1,000)
1 - Buffalo Creek	11	6,730	490	2,900
44 - Cattaraugus Creek	44	67,970	3,290	21,770
56 - Eighteenmile Creek	6	3,360	280	2,617
57 - Ellicott Creek	3	2,060	160	684
72 - Big & Little Sister Cks.	6	5,610	350	2,552
115 - Smoke Creek	1	120	30	122
148 - Upper Tonawanda Creek	4	16,980	1,130	2,308
203 - Wanakah - Lake Erie	-	-	-	-
238 - Middle Tonawanda Creek	1	500	100	294
239 - Lower Tonawanda Creek	-	-	-	-
240 - Murder Creek	2	1,990	200	421
241 - Ransom Creek	-	-	-	-
244 - Scajaquada Creek	-	-	-	-
245 - Mud Creek	-	-	-	-
TOTAL - 14 Watersheds	78	105,320	6,030	33,668

2/ Maximum storage for each potential site.

Design and cost information for each potential site can be found in Appendix A, *Preliminary Upstream Reservoir Studies*. This supplement describes the procedures used, contains maps showing the location of each site, and provides information concerning the design, cost and geology of each structure. Most of the potential sites are located in the Allegheny Plateau area of the Basin, particularly in Cattaraugus Creek, with only scattered sites in the Ontario Lake Plains area.

Sixty-five of the reservoir sites have potential for more than one purpose identified in this study. Sites with potential for irrigation and flood control were selected by the United States Department of Agriculture. The Department of Environmental Conservation selected those sites with potential for recreation and fish and wildlife.

## FLOOD PREVENTION SITES

Fifteen sites have been identified which could help relieve downstream flood damages. No one site or group of sites was found to provide a feasible structural plan for a single purpose flood prevention project. These sites could be developed for multiple purpose with flood prevention being the last

increment. Figure 7.2 shows the location of these sites.

## IRRIGATION SITES

Thirty-seven sites were originally selected as having potential to supply irrigation water. Locations of these sites are shown in Figure 7.3.

From the original number identified, 13 sites were picked as having the best potential for supplying irrigation water to specified areas of need. Table 7.3 shows that these sites can supply 6,440 acre-feet. Each acre-foot is estimated to irrigate one acre of land in the vicinity of the site location. Estimated installation cost for supplying this needed storage is about \$2.8 million. Other potential irrigation sites are listed in Appendix A.

Table 7.3 Potential Irrigation Sites

Watershed	: : Site : Numbers	: : Beneficial : Storage : (Ac.Ft.)	: Expected: : Yearly : Need : (Ac.Ft.)	: Installation : Cost : (\$1,000)
1 - Buffalo Creek	1-6,7	830	700	262
44 - Cattaraugus Creek	44-1,7, 22,23,27, 34,56,59, 64	15,240	4,440	2,015
72 - Big & Little Sister Cks.	72-8	800	800	277
238 - Middle Tonawanda Creek	238-2	500	500	294
TOTALS	13 sites	17,370	6,440	2,848

3/ Beneficial storage is based on topographic limitations or an annual runoff of 11 inches.

4/ Cost computed for storage to meet expected yearly needs. Cost does not include distribution pumping system necessary for sites 44-22 and 44-64.

## LOW FLOW AUGMENTATION SITES

Forty-eight sites could provide augmentation water for waste assimilation during periods of minimum stream flow. These sites can provide 72,350 acre-feet per year at an estimated cost of about \$22.2 million. Twenty-five sites are so located that they could supply water for both irrigation and water quality uses which are often compatible purposes.

Table 7.4 gives the total amount of water and cost for supplying various stream reaches. Figure 7.4 shows the location of sites.



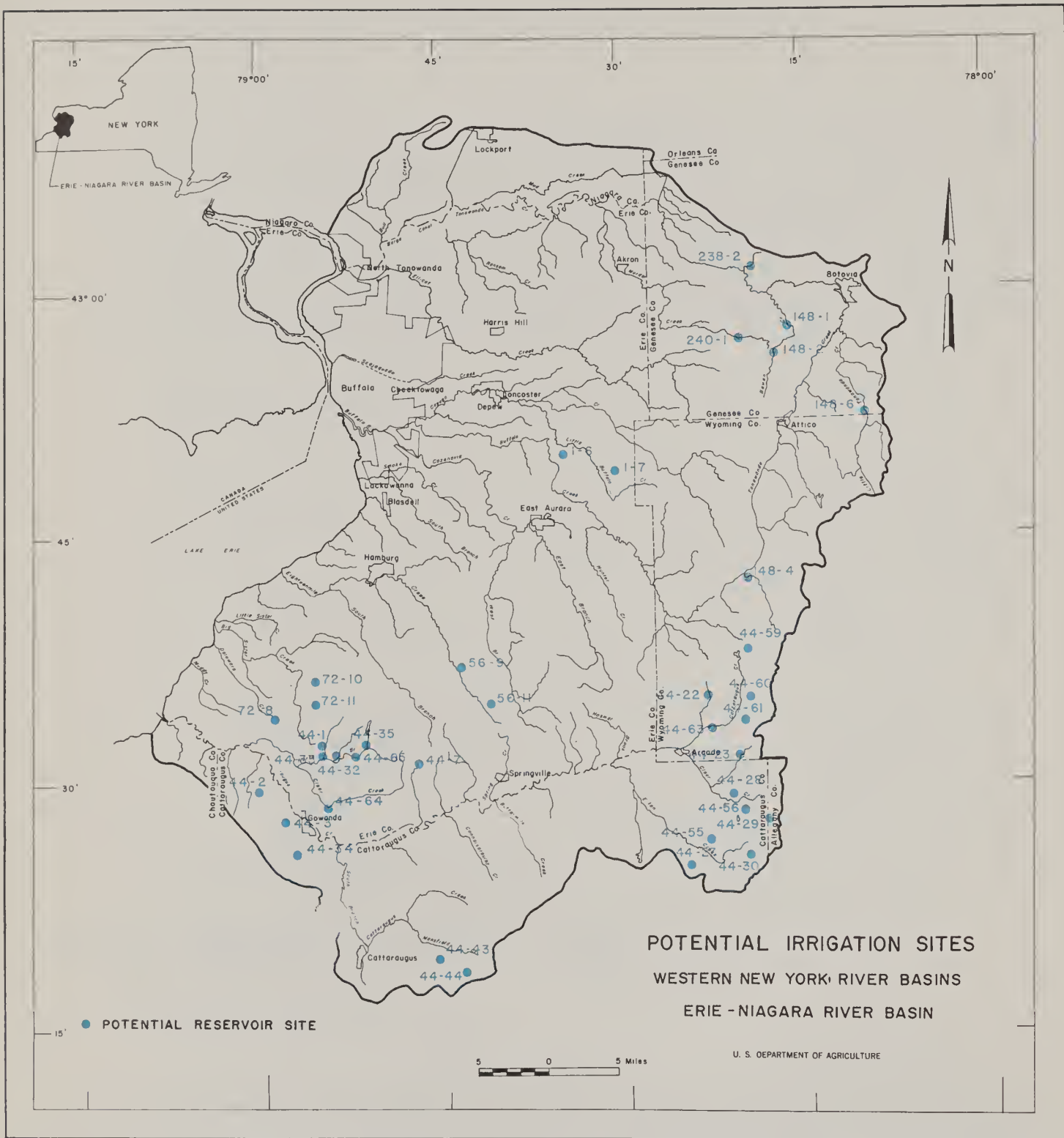


FIGURE 7.3

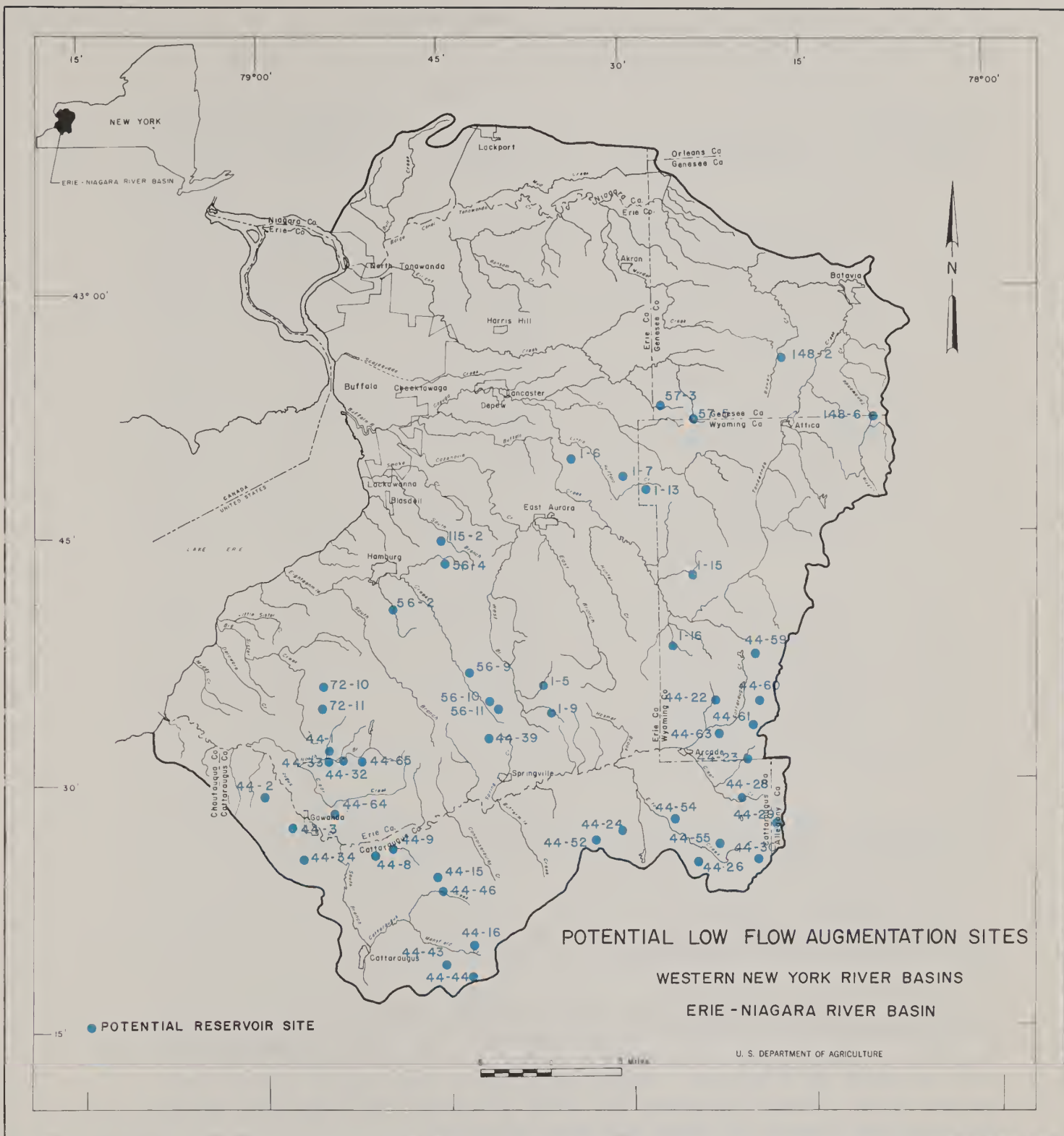


FIGURE 7.4

Table 7.4. Potential Sites for Low Flow Augmentation

Watershed No.	Streams Supplied	Sites	Beneficial Storage 5/ Acre Feet	Total Install. Cost (\$1,000)
1	W. Cazenovia Creek	1-5,9	2,030	702
	Little Buffalo Creek	1-6,7,13	1,370	428
	Buffalo Creek	1-15,16	1,800	965
44	Lower Cattaraugus Creek	44-1,2,3,8 9,32,33,34 64,65	16,110	4,897
	So. Br. Cattaraugus Ck.	44-15,16,43 44,46	1,920	1,680
	Elton Creek	44-24,26,30, 52,54,55	8,310	2,757
	Spring Brook	44-39	450	272
	Clear Creek at Sandusky	44-23,28,29	2,900	858
	Upper Cattaraugus Ck.	44-22,59,60, 61, 63	17,680	3,988
56	Eighteenmile Creek	56-2,4,9, 10,11	2,940	2,390
57	Ellicott Creek	57-5	1,860	369
72	Big Sister Creek	72-10,11	1,040	1,523
115	Smoke Creek	115-2	120	122
148	Upper Tonawanda Creek	148-2,6	13,820	1,216
TOTAL		48 Sites	72,350	22,167

5/ Beneficial storage is based on topographic limitations or an annual runoff of 11 inches.

#### MUNICIPAL AND INDUSTRIAL WATER SUPPLY SITES

Eleven sites were selected which had potentials to supply municipal and industrial water to locations having inadequate or underdeveloped water supplies. These sites could supply a total of 41,040 acre-feet at a cost of about \$6.3 million. Eight sites could also supply needed irrigation water. Table 7.5 shows the total potential for supplying municipalities and Figure 7.5 shows the site locations.



Table 7.5. Potential Sites for Municipal and Industrial Water Supply

Watershed	: : Site :Numbers :	: : Beneficial: : Storage : (Ac.Ft.)	: : Total : Instal. : Cost : (\$1,000):	: : Area : Supplied
44 - Cattaraugus Creek	44-3,34, 64	8,080	1,723	Village of Gowanda
44 - Cattaraugus Creek	44-22,63	14,370	2,708	Village of Arcade
44 - Cattaraugus Creek	44-23	1,680	294	Hamlet of Sandusky
57 - Ellicott Creek	57-5	1,870	369	Hamlet of Darien Ctr.
72 - Big & Little Sister Cks.	72-7,9	1,810	426	Hamlet of Farnham
148 - Upper Tonawanda Creek	148-6	12,220	563	City of Batavia
240 - Murder Creek	240-1	1,010	205	Village of Akron
TOTALS	11 Sites	41,040	6,288	

6/ Beneficial storage is based on topographic limitations or an annual runoff of 11 inches.

7/ Cost includes that for installation of the structures only and does not include cost of delivery (piping, pumping, etc.).

## RECREATION SITES

Sixty-eight sites (Figure 7.6) were identified by the New York State Division of Water Resources as having favorable characteristics for recreation development. These sites would provide about 5,530 surface acres at an estimated cost of about \$29 million. This cost does not include basic facilities for recreation. Appendix A lists all the potential recreation sites and pertinent data.





CAMPING AND SWIMMING AT A RECREATION DEVELOPMENT

#### FISH AND WILDLIFE SITES

Fifty-eight sites were selected by the New York State Division of Fish and Wildlife as having potential for fish and wildlife habitat development. (Figure 7.7) These sites would provide a total of about 5,200 surface acres at an estimated cost of about \$24.1 million. The \$24.1 million cost is for structural work only and does not include basic facilities for fish and wildlife development.



## CHANNEL IMPROVEMENT

### FLOOD CONTROL

Potential for channel improvement to provide flood control was found on Tannery Brook at the village of East Aurora. Channel improvement on three other areas in the Tonawanda Creek drainage could provide both flood control and agricultural drainage. Over 40,000 acres could be benefited by a total of about 90 miles of channel improvement on tributary creeks and major lateral ditches. The total installation cost would exceed \$7.4 million.

Figure 7.8 shows the location of needed channel improvement within USDA study areas.

### TANNERY BROOK

A flood problem exists in the village of East Aurora where restricted channel capacity of Tannery Brook and ice jams result in flooding almost annually. Three possible solutions to this problem were identified: (a) channel improvement in the village of East Aurora, (b) channel improvement plus a small flood control reservoir, and (c) a diversion channel just above the problem area to direct floodwater into Buffalo Creek. The diversion channel offers the best potential for reducing flood damages. A detailed report of this potential development is contained in Appendix B.

### UPPER TONAWANDA CREEK

Channel improvement on Tonawanda Creek could benefit approximately 3,000 acres of agricultural land in the Upper Tonawanda watershed. However, even with a Corps of Engineers' flood protection project installed, most of this area would still be subject to frequent flooding and any channel improvement would reduce the benefits of a Corps project to protect Batavia.

A flood prevention project, such as the Corps of Engineers is now planning on Tonawanda Creek, is needed in conjunction with channel improvement on tributaries. Another 24,000 acres of potentially excellent agricultural land is limited in its use because of flooding and inadequate drainage outlet condition on the tributaries of Tonawanda Creek. This area could be benefited now from tributary channel improvement for flood control and drainage.

The 4.6 miles of potential channel improvement, in addition to the Corps' project, would cost an estimated \$4.1 million. The feasibility of this development is not favorable at this time. See Appendix B for more details.



## LOWER TONAWANDA AREA

About 40,000 acres of land along the Tonawanda Creek have an excellent potential for agricultural development (see Figure 7.9). About 24,000 acres could benefit greatly by channel improvement on the tributaries to Tonawanda Creek. This channel widening and deepening would reduce flooding and improve drainage even though Tonawanda Creek would continue to flood frequently.

Another 16,000 acres of agricultural land could be greatly enhanced if the proposed Corps of Engineers' Tonawanda Creek project was developed and reduced the frequency of flooding from Tonawanda Creek. This protection coupled with channel improvement on the tributaries would not only make possible more intensive agricultural use of these 16,000 acres, but also would improve the drainage outlet conditions of about 14,000 acres in bordering areas.

Black Creek is a typical project area encompassing 4,700 acres within the Lower Tonawanda flood plain which serves as an example of the many individual channel improvement projects possible. However, the Black Creek project is one of those which would require the development of a Corps of Engineers flood protection project on Tonawanda Creek which would also provide adequate drainage outlets. A watershed investigation report is included in Appendix B.

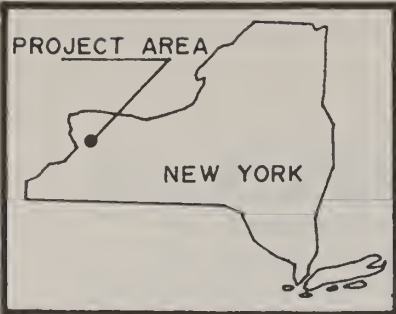
A high degree of flood protection for urban use is not practical in most of the area. Therefore, it is both reasonable and desirable that this area be set aside for agricultural or other open space use by flood plain regulation.

## MURDER CREEK

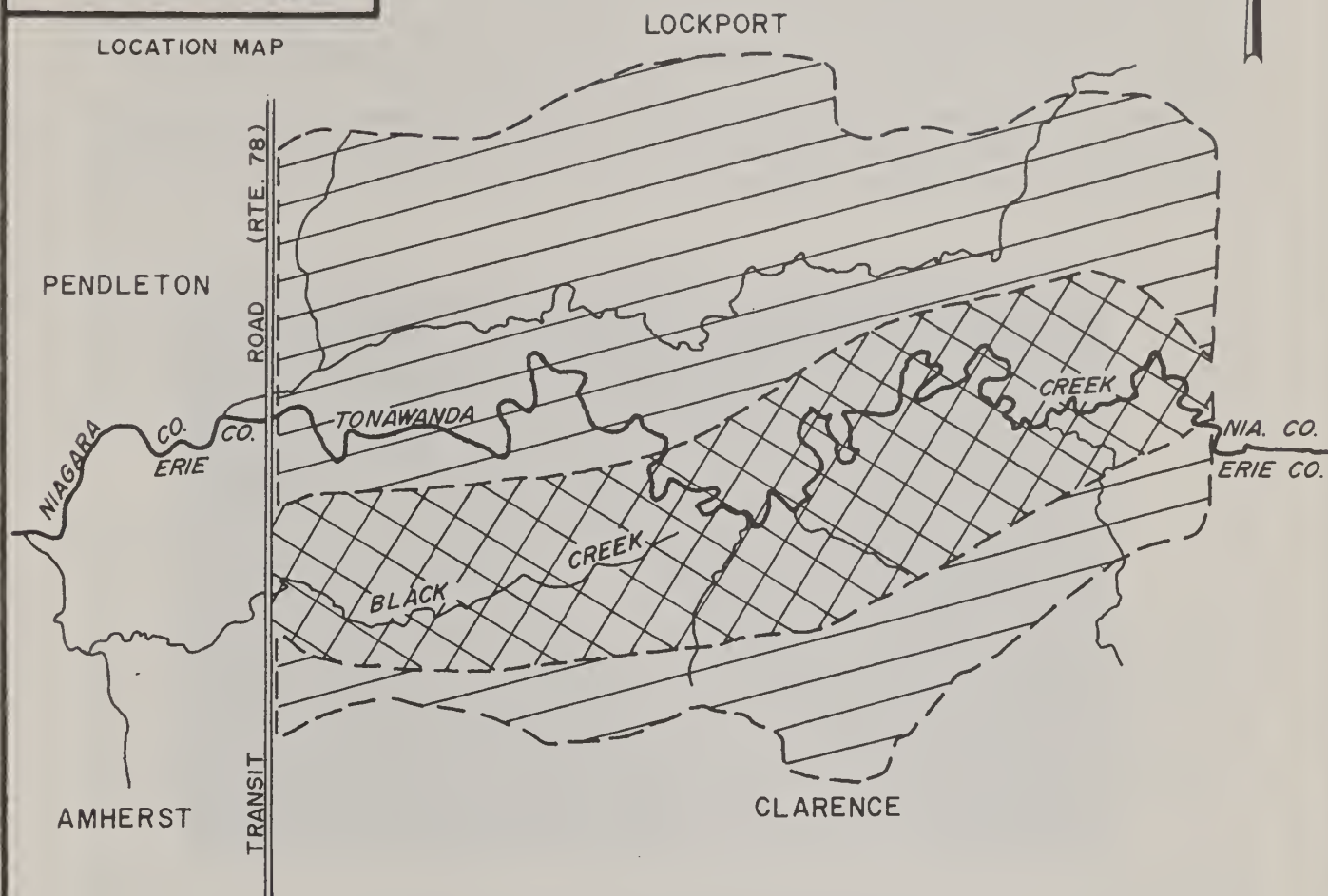
In this area ponding and overbank flow from Murder Creek has retarded full development of the land. Correction of this problem lies in channel improvement, such as widening or deepening, or a combination of both. The 1,050 acres that would be benefited lie in a relatively narrow flood plain. Very little cropland is in evidence near the stream which is bordered mainly by pasture, forest, or idle land. Under these circumstances, the feasibility for channel improvement at this time is not favorable. A watershed evaluation report on this area is contained in Appendix B.



## DRAINAGE

Channel improvement to provide agricultural drainage has its greatest potential in the Lower Tonawanda area subwatersheds. Channel improvement in these 40,000 acres would not only provide flood control, but would greatly improve agricultural drainage. These group projects are represented in the previous paragraphs on channel improvement for flood control.



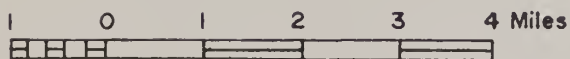
LOCATION MAP



- AREA 1  24,000 acres of potentially excellent agricultural land which could benefit from tributary channel improvement for drainage and flood control.
- AREA 2  16,000 acres of potentially excellent agricultural land directly affected by frequent flooding of Tonawanda Creek.

## LOWER TONAWANDA AREA POTENTIAL PROJECT DEVELOPMENT

WESTERN NEW YORK RIVER BASINS  
ERIE-NIAGARA BASIN



U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

FIGURE 7.9

There are an additional 18,000 acres scattered throughout the Lower Tonawanda Area subwatersheds which can be provided adequate drainage through the construction of new lateral ditches and the enlargement of existing ditches. Drainage developments would involve small groups of landowners and individual on-farm construction.

The cost of constructing and enlarging such channels is estimated to be \$20.50 per acre. This construction would involve a total cost of about \$370,000 for the entire 18,000 acres, and could be accomplished through the Public Law 46 program and possible cost-sharing provided through the Agricultural Conservation Program.



CONSTRUCTED DRAINAGE CHANNELS IMPROVE  
THE POTENTIAL OF AGRICULTURAL LAND

Ownership patterns on other areas of the Ontario Plain and in the Eden Valley area may require, in some instances, the development of drainage improvements through small group (2-3 landowners) action. For the most part, adequate outlets are available or feasible to construct on-farm in this area and on the plateau because of the more sloping topography.

With adequate outlets, there are no restrictions to the installation of field drainage measures. Again, group and on-farm measures can be installed through the Public Law 46 program and possible cost-sharing provided through the Agricultural Conservation Program.

## FLOOD PLAIN MANAGEMENT

Floodwater damage which occurs along Slate Bottom, Eighteenmile, Ellicott and Upper Tonawanda Creeks is minor. There does not appear to be any potential under USDA programs for structural measures on these creeks.

However, due to the rapid urbanization of these areas, local action is urgently needed to regulate the development of the flood plain. By taking action now, the installation of costly structural measures for flood control in the future can be prevented.

Flood plain regulations could be enacted to control urban encroachment along these and other streams thereby reducing future flood damages. These flood plain regulations could include zoning to establish specific land use, and other controls such as building codes and flood proofing. Moreover, owners of structures now on the flood plain can install flood proofing measures to reduce damages.

## WATERSHED MANAGEMENT

Agricultural and forest lands are capable, not only of producing necessary food and fiber, but also of multiple use management for watershed protection and improvement, recreation development, fish and wildlife habitat improvement, and enhancement of the environment. The soil column underlying the agricultural and forest cover serves as the largest reservoir in the Basin. It holds the ground water which maintains base stream flow.

There will be some shifting of land use in many areas of the Basin. Cropland and pasture acreages will decline while total forest land will increase. Moreover, some losses of agricultural and forest lands will occur for reservoirs, land rights, housing developments and other urban uses. Land will be acquired for park and recreation areas.

The physical potential of the Basin's land to improve hydrologically is high to medium. Given adequate protection and management through land use planning and the application of land treatment measures, the hydrologic conditions of these lands should continue to improve. Similarly, land use planning and the application of land treatment measures on urban-developing lands will minimize the deterioration of the land and water resources.

Within the Basin are legally constituted local bodies authorized to sponsor and implement watershed projects and other land and water related programs. Further, these bodies, through cooperating federal and state agencies, can provide technical assistance in land use planning and the installation of land treatment measures to landowners, groups, communities, and urban developers.

## IRRIGATION

Over 136,000 acres in the Basin are potentially suitable for irrigation. Seven subwatershed areas were investigated to determine irrigation potential. Each area was found to have a favorable benefit-cost ratio. Thirteen reservoir sites, primarily for irrigation development, could provide sufficient water to irrigate 6,400 acres of cropland. Details on the seven subwatershed areas are given in Appendix C, *Irrigation*.

In other irrigable areas where projects are not feasible, much of the increased demand for irrigation water can be met by development of large and small upstream reservoir sites. Other sources such as ground water and streams can be utilized where available.

Additional individual reservoir sites which have the potential for irrigation use are listed in Appendix A.

## WATER SUPPLY

Expansion of existing supply systems from Lake Erie and the Niagara River will no doubt take place. However, only Akron, Colden, Farnham and Gowanda have the potential to be supplied from these sources. In other areas, ground water and reservoir sites may be more economical in supplying the ever-increasing demand. Potential reservoir sites are shown in Figure 7.5. Most communities needing water, however, will need to develop ground water sources.

Rural domestic and livestock water supply demand is for the most part being met by ground water. Livestock use and spray water is met through the construction of farm ponds as well as ground water development. Farm ponds supplement ground water supplies during the spring, summer, and fall months.

Ground water may be a potential source which can be further utilized to supply future needs for on-farm consumption and rural communities. Unfortunately, ground water is not evenly distributed and is subject to a great deal of variations in quantity and quality within short distances. However, it appears that there is adequate ground water over the Basin to satisfy on-farm supplies, except for irrigation, through the development of individual wells.

Locally, ground water supplies may be adequate for irrigation. Further studies need to be made to more adequately define ground water quantity, quality and location for development by rural communities.

## WATER QUALITY CONTROL

The Water Resources Commission publication *Developing and Managing the Water Resources of New York State* reports on the potential for managing water quality:

"The State Water Resources Commission has classified the streams in the region as to their best usage in the interest of the public. Using these classifications and specified minimum dissolved oxygen contents, preliminary estimates have been made of the effects of present and future bio-chemical oxygen demand discharges on the streams in the region.

"It is indicated that augmentation during periods of minimum stream flow should be considered for waste assimilation at the following locations in the Erie-Niagara Basin; Amherst and Alden on Ellicott Creek, Depew and Lancaster on Cayuga Creek, Cheektowaga on Scajaquada Creek, East Aurora on Cazenovia Creek, Gowanda on Cattaraugus Creek, Elma on Buffalo Creek and Batavia on Tonawanda Creek."

The State of New York through its *Pure Waters* program initiated in 1965 is attempting to ensure that all waters will meet the stream classification standards set by the Water Resources Commission. As a direct result of this program and its available funds, many municipalities and industries are in the process of planning and constructing adequate waste treatment facilities. This alone will do much to alleviate some of the problems. The potential of augmentation from reservoir sites, which is also needed to assist during times of natural low flow, is good.

Continuing research is leading to the development of pesticides with a higher degree of specificity and with corresponding reduced chances of damage to non-target organisms. Biological and other methods of pest control are being developed which will eliminate the need for chemicals in controlling some pests.

Because of the methods of placement of fertilizers on agricultural lands almost all of the fertilizer is used by the crop and losses to streams is minimal. This loss can be kept at this level by continuing to educate users to the possible harmful effects of fertilizers and crop production benefits derived from proper fertilizer placement.

Further, land treatment measures installed on uplands can reduce sediment, fertilizer and pesticide losses from the land to a minimal level. Again, continuing education of landowners stressing the benefits derived from the installation of land treatment measures is necessary.



## OPPORTUNITIES FOR DEVELOPMENT AND IMPACT OF USDA PROGRAMS

There are 14 project developments which can be justified under existing United States Department of Agriculture programs. The opportunity exists for these projects to be developed in the near future to meet the increasing demands upon water and related land resources.

Figure 8.1 shows the location of the 14 potential USDA project developments. Seven projects are primarily for irrigation water supply with an excellent potential for recreation and/or fish and wildlife development in six of these, and a potential for supplying low flow augmentation in three. One project would provide flood protection to the village of East Aurora and five projects are single site developments for recreation in the Seneca Trails Resource Conservation and Development Area. One project development is Middle and Lower Tonawanda Creek which would provide flood control and drainage. Table 8.1 lists the potential developments applicable under USDA programs.

The total estimated installation cost of all potential USDA developments is \$13,301,400. Of this total \$5,102,800 would be federal cost and \$8,198,600 non-federal cost. Specific details on each project area can be found in the Appendix.

Land treatment is also recommended throughout the Basin. The estimated cost of installing needed land treatment measures up to the year 1980 is \$6,378,600 of which \$2,730,000 would be borne by federal funds and \$3,648,600 by non-federal funds.

### PUBLIC LAW 566 PROJECTS

Projects applicable to Public Law 566 are those potential developments which have flood control or irrigation as the primary purpose. The seven irrigation projects and two flood control projects which could be implemented under PL-566 are listed in Tables 8.1 and 8.2. Total installation cost is estimated to be \$10,062,000. Of this, about \$4,640,800 would be federal cost and about \$5,421,200 would be non-federal cost.

It should be recognized that present federal policies are favorable only to projects having flood control as the primary purpose.



TABLE 8.1 - POTENTIAL PROJECT DEVELOPMENTS APPLICABLE UNDER USDA PROGRAMS

Watershed		Project Area	Purpose	USDA Program Applicable	Primary Agency Involved
No.	Name				
1	Buffalo Creek	1-A Tannery Brook 1-B Cayuga & L. Buffalo Creeks	Flood Control <u>Irrigation, Recreation</u>	Public Law 566 Public Law 566	SCS SCS
44	Cattaraugus Creek	44-A Clear Creek 44-B Thatcher Brook  44-C Upper Cattaraugus Creek 44-D Elton Creek  Site 44-9 (Waterman Brook) Site 44-19 (Trib. to McKinstry Cr.) Site 44-20 (Trib. to Gooseneck Cr.) Site 44-24 (McKinstry Creek) Site 44-42 (Trib. to S. Branch Cattaraugus Creek)	<u>Irrigation, Recreation</u> <u>Low Flow Augmentation</u> <u>Irrigation, Flood Control</u> <u>Recreation, Low Flow</u> <u>Augmentation</u> <u>Irrigation, Recreation</u> <u>Low Flow Augmentation</u> <u>Irrigation, Recreation</u>  Recreation Recreation Recreation Recreation Recreation	Public Law 566   Public Law 566 Public Law 566  Resource Conservation and Development Resource Conservation and Development Resource Conservation and Development Resource Conservation and Development Resource Conservation and Development	SCS   SCS SCS  SCS SCS SCS SCS SCS
72	Little & Big Sister Cks.	72-A Delaware and Muddy Creek	<u>Irrigation, Recreation</u>	Public Law 566	SCS
238	Middle Tonawanda Creek	238-A North Pembroke	<u>Irrigation</u>	Public Law 566	SCS
Portions of	Portions of				
239	Ransom	Lower Tonawanda	Flood Control & Drainage	Public Law 566	SCS
241	Lower Tonawanda	(241-A Black Creek is a			
245	and Mud Creeks	sample project within this area)			
-	All	All Basin Land	Land Treatment	All Programs	SCS-FS

1/ For projects with multiple purpose potential the underlined purpose is the primary purpose for which the project is economically justified, with or without the other potential purposes listed.

TABLE 8.2 - COST AND BENEFIT DATA FOR POTENTIAL PL-566 PROJECT DEVELOPMENTS

Watershed No.	Name	Project Area	No. Sites	Miles Channel	Installation Cost (\$1,000)		Avg. Ann. Cost (\$1,000)	Avg. Ann. Benefits (\$1,000)	Benefit Cost Ratio	Acres Benefited		2/ Purpose
					Federal	Non-Federal				Flood	Irrig.	
1	Buffalo Creek	1-A Tannery Brook	-	2.3	213.1	80.1	15.9	39.9	2.5:1	40	-	FC
		1-B Cayuga & Little Buffalo Creeks	3	-	202.8	230.9	33.6	75.0	2.2:1	-	700	I, Rec.
44	Cattaraugus Creek	44-A Clear Creek	4	-	480.8	1,153.9	101.8	179.9	1.8:1	-	2,290	I, Rec., LF
		44-B Thatcher Brook	2	-	605.5	863.8	94.2	128.9	1.4:1	3/	300	I, FC, Rec. LF
		44-C Upper Cattaraugus Cr.	5	-	685.3	1,359.7	124.3	181.5	1.5:1	-	1,550	I, Rec., LF
		44-D Elton Creek	2	-	305.3	400.1	56.0	110.0	2.0:1	-	300	I, Rec.
72	Little and Big Sister Creeks	72-A Delaware-Muddy Creeks	2	-	381.5	541.5	71.9	152.0	2.1:1	-	800	I, Rec.
238	Middle Tonawanda Creek	238-A North Pembroke	1	-	125.1	168.6	14.9	15.0	1.0:1	-	500	I
Portions of 239	Portions of Ransom	Lower Tonawanda										
241	Lower Tonawanda and											
245	Mud Creeks											
		Present Conditions	-	50	1,061.4	402.6	131.9	344.0	2.6:1	24,000	-	FC, Dr.
		Future Conditions 4/	-	40	580.0	220.0	5/	5/	-	16,000		
TOTAL			19	92.3	4,640.8	5,421.2	-	-	-	40,040	6,440	

2/ I - Irrigation; FC - Flood Control; LF - Low Flow Augmentation; Rec. - Recreation; Dr. - Drainage.

3/ Not measured.

4/ With reduction in Tonawanda Creek Flooding.

5/ Total cost and benefits cannot be estimated until Corps of Engineers plans are complete for the entire Tonawanda Creek project.

Costs and benefits shown for future conditions include only tributary channel improvement.

## FLOOD CONTROL

### PROJECT 1-A - TANNERY BROOK

The purpose of this project would be to provide flood protection primarily to about 40 acres of urban properties within the village of East Aurora. A diversion is recommended to direct flood flows into a tributary to Buffalo Creek. Channel improvement will be required on Tannery Brook below the diversion and within the village.

The total installation cost of flood prevention measures is estimated to be \$293,200. This cost does not include the non-project local cost for the culvert under the Expressway. Annual cost of \$15,900 and annual benefits of \$39,900 result in a favorable B:C ratio of 2.5:1. Details of the proposed project can be found in Appendix B of this report.

The Aurora Expressway is being constructed across the proposed diversion location. When this highway is completed the above cost no longer will apply. Future studies will then need to be made if an alternate plan is desired. It is expected that any other alternative will be a great deal more costly.

### LOWER TONAWANDA AREA

This area has been designated as a project area although many individual projects would be developed within its boundaries. A typical example of one of these potential projects is project 241-A, Black Creek which is described in detail in Appendix B. Black Creek was selected to be studied in detail to provide a basis for cost estimates and benefits for the whole Lower Tonawanda area.

Projects in the Lower Tonawanda area can provide flood protection and drainage for about 40,000 acres. This can be accomplished by channel improvement on tributaries to Tonawanda Creek. About 16,000 acres of the total area will need not only tributary channel improvement but also protection from flooding by a Corps of Engineers' project on Tonawanda Creek. The remaining 24,000 acres can be benefited immediately by tributary channel widening and deepening even though Tonawanda Creek continues to flood frequently.

The total Lower Tonawanda area development would involve about 90 miles of channel improvement at an estimated installation cost of \$2,264,000. Approximately \$1,641,400 of this could be borne by federal monies under Public Law 566.

For the 24,000 acres presently capable of being developed, 50 miles of channel improvement would cost an estimated \$1,464,000. This amounts to \$131,900 annually with \$344,000 annual average benefits resulting in a 2.6:1 benefit-cost ratio.

Tributary channel improvement for the other 16,000 acres would involve 40 miles of tributary enlargement at an estimated total cost of \$800,000. Annual cost and benefits would depend upon the cost and effectiveness of the Corps of Engineers' Tonawanda Creek project.

## IRRIGATION

Seven potential irrigation projects can provide water for about 6,440 acres of land from 13 sites. The potential irrigation projects were first economically justified for single purpose irrigation. Then other potential purposes were added to each according to the possible existing needs. Detailed information on each project is found in Appendix C.

### PROJECT 1-B - CAYUGA AND LITTLE BUFFALO CREEK

Two sites would supply irrigation water for about 700 acres. One site could be developed for a 20-acre recreation and/or fish and wildlife lake. The total estimated installation cost for these three sites is \$433,700.

### PROJECT 44-A - CLEAR CREEK

Three sites can supply irrigation water for about 2,290 acres and one of these sites can also provide 4,020 acre-feet for low flow augmentation to the lower 5 miles of Cattaraugus Creek. An additional site can be developed for a 50-acre recreation and/or fish and wildlife lake. These four sites are estimated to cost \$1,634,700. One of the irrigation sites is close enough to the village of Gowanda to provide municipal and industrial water if needed.

### PROJECT 44-B - THATCHER BROOK

The two sites in this project would cost an estimated \$1,469,300. One would provide irrigation water for 300 acres and 740 acre-feet for low flow augmentation in Cattaraugus Creek below Gowanda. The other site would be developed for a 100-acre recreation and/or fish and wildlife lake.

The irrigation site also would have a possibility of supplying municipal and industrial water to the village of Gowanda if future studies show the need to include this as a project purpose.

### PROJECT 44-C - UPPER CATTARAUGUS CREEK

The total cost of \$2,045,000 includes the estimated installation cost of five impoundment sites. Four sites supply irrigation water for 1,550 acres of land - three of these also would supply 2,890 acre-feet for low flow augmentation to Clear Creek at Sandusky and the village of Arcade. Another site of 100 surface acres would be developed for recreation and one fish and wildlife.

One of the irrigation sites is suitable for supplying municipal and industrial water to the village of Arcade if ever this should be included as a project purpose.

#### PROJECT 44-D -ELTON CREEK

This project includes two reservoir sites, one to irrigate 300 acres and the other to be developed for a 90-acre recreation and/or fish and wildlife lake. The estimated total installation cost is \$705,400.

#### PROJECT 72-A - DELAWARE AND MUDDY CREEKS

The two sites costing an estimated \$923,000 would irrigate 800 acres from one site and provide 170 surface acres for recreation and/or fish and wildlife development at the other site.

The recreation site is in an excellent location to provide municipal and industrial water to the hamlet of Farnham if needed.

#### PROJECT 238-A - NORTH PEMBROKE

Only one site costing an estimated \$293,700 is included in this project for supplying irrigation water to 500 acres.

### RESOURCE CONSERVATION AND DEVELOPMENT PROJECTS

A small portion of the Basin, northern Cattaraugus and Chautauqua Counties, and the northwestern corner of Allegany County, is in the Seneca Trails Resource Conservation and Development Project.

Five single purpose recreation sites shown in Table 8.3 are recommended in this report as potential development projects within the RC&D area. These sites range in cost from \$358,000 to \$1.1 million, including facilities. They would furnish 400 water surface acres for recreation and/or fish and wildlife use. Federal funds could provide between \$46,000 and \$152,000 (depending on the site) for technical assistance and between \$310,000 and \$950,000 would be borne by local funds. These sites are additional to the project measures proposed in the RC&D project plan published in May 1968.

The potential of the RC&D program is great in accelerating going land treatment and structural programs of resource conservation and development. This program is in the development phase and in the future should be a major tool to assist in solving land and water conservation problems.

### LAND TREATMENT PROGRAMS

Needed land treatment can be implemented through PL-46, cooperative forestry programs, and related authorities. Technical assistance for the

Table 8.3. Cost and Benefit Data for Potential Resource Conservation and Development Projects.

Site No.:	INSTALLATION COST				Average :			
	Structure : (\$1,000)	Facilities : (\$1,000)	Total : (\$1,000)	Federal : (\$1,000)	Non-Fed. : (\$1,000)	Annual : Cost (\$1,000)	Annual : Benefits (\$1,000)	Benefit : Cost Ratio : Use
44-9	743.0	196.3	939.3	152.0	787.3	69.6	114.3	1.6:1 Rec.
44-19	336.0	146.0	482.0	69.0	413.0	41.2	85.1	2.1:1 Rec.
44-20	235.0	122.6	357.6	48.0	309.6	32.3	71.4	2.2:1 Rec.
44-24	883.0	212.5	1,095.5	147.0	948.5	79.2	123.8	1.6:1 Rec.
44-42	229.0	136.0	365.0	46.0	319.0	34.3	79.2	2.3:1 Rec.

establishment of land treatment practices is provided through such agencies as the Soil Conservation Service, the Forest Service, and the New York State Division of Lands and Forests. Cost-sharing on land treatment practices with landowners can be provided through the Agricultural Conservation Program which is administered by the Agricultural Stabilization and Conservation Service.

Specific areas which present the opportunity for development of land treatment measures are:

#### CROPLAND (180,000 acres)

For drainage of excess water such measures as tile drains, open ditches, water control structures, bedding and land grading will be required to reduce the problems. This will result in better quality and quantity of crops as well as allow the use of the land earlier in the year on 91,000 acres.

On the 87,000 acres where erosion is a problem, contouring, strip cropping, diversions and grassed waterways would help reduce the amount of soil lost to the streams. Retention of this soil will result in better productivity and less sedimentation in ditches and streams.

Shallow and droughty soils on 2,200 acres of the Basin yield poor crops and some of this land should be converted to pasture or forest land for maximum efficiency.

#### PASTURE (87,000 acres)

Establishment and improvement of cover through planting, mowing and fertilizing is needed on 66,000 acres of pasture land. These practices, along with diversions, tile drains and open ditches will help to reduce the erosion and excess water problems. Better land management to prevent overgrazing on 7,400 acres is also needed.

#### FOREST LAND (147,000 acres)

Hydrologic stand improvement work is needed on approximately 59,000 acres of forest land in the Basin. These operations improve forest hydrologic conditions through increased development of litter and humus and maintenance of adequate vegetative cover. These objectives are achieved by favoring the establishment and development of desirable species and maintaining standard stocking conditions favorable to rapid growth and production of maximum amounts of litter and humus. Hydrologic cultural operations include thinnings, weedings, improvement, salvage and harvest cuts. These operations will improve hydrologic condition of the stands and at the same time benefit the future timber-based economy and recreation values of the Basin.

There are approximately 51,000 acres of forest land that need protection from improper cutting practices. Estimates indicate that there is a total of 31,000 acres of forest land which need protection from grazing. Fencing the forest land from domestic livestock prevents the impairment of forest hydrologic conditions.

Changes in land use over the past several years have resulted in many acres being converted to plantations. Many cutover areas have failed to regenerate themselves and have had to be reforested through planting. It is estimated that at the present time nearly 4,000 acres need this treatment. Projections indicate that an additional 50,000 acres will become forest land.

It is estimated that approximately 1,500 additional acres of forest land need tree planting for erosion control. In addition, there are approximately 700 acres of erosion control work needed to reduce sediment from erosion caused by poorly located and constructed logging roads and skid trails.

If the Basin is to receive the maximum benefits from its water, timber, recreation facilities, and wildlife habitat, all forest land must be protected from fires.

#### OVERALL PROGRAM

Table 8.4 shows the land treatment needs and cost estimate for the total program and the program to 1980. Of the total land treatment cost of \$21,992,000, a total of \$17,674,300 is for installation cost and \$4,317,700 represents the technical services. The program cost of \$6,378,600 for 1980 includes \$5,211,500 for installation cost and \$1,167,100 for technical services.

Table 8.4. Cost Summary for Future Land Treatment Needs 6/

Land Use	: Total Program		: Program to 1980	
	: Acres Needing	: Estimated	: Acres to be	: Estimated
	: Treatment	: Cost \$ <u>7/</u>	: Treated	: Cost \$ <u>7/</u>
Cropland	180,000	14,456,800	65,000	5,287,800
Pasture	87,000	4,298,200	13,000	644,800
Forest	147,000	3,237,000	14,500	446,000
TOTAL	414,000	21,992,000	92,500	6,378,600

6/ Conservation Needs Inventory;

7/ Cost Estimates by the Soil Conservation Service and the U. S. Forest Service, New York.

## RURAL DEVELOPMENT

Rural development is the U. S. Department of Agriculture's special effort to provide expanded farm and nonfarm employment, income opportunities, and more attractive living conditions in nonmetropolitan areas. The approach is to assist people to help themselves. Departmental agencies will provide technical assistance to communities and individuals in support of comprehensive planning and development.

## IMPACTS OF POTENTIAL DEVELOPMENT

The installation of the 14 project developments applicable under PL-566 and the RC&D program would have both physical and economical effects, or impacts, in the Basin. Table 8.5 summarizes the physical impact on the Basin, the benefits to national efficiency and the regional effects of the proposed USDA project developments.

The projects would have physical impact which includes providing irrigation water for about 6,400 acres, decreasing flooding and improving drainage for about 40,000 acres, and providing water-based recreation amounting to over 700,000 annual visitor days. Also, about 7,600 acre-feet of reservoir storage is available for low flow augmentation.

Benefits for low flow augmentation were conservatively estimated as equivalent to the costs. Regional effects were not estimated. These project developments would provide an estimated \$1.7 million in annual benefits to national efficiency objectives. The regional effects are estimated at over \$3.3 million annually with an additional estimated \$25 million during project installation from installation expenditures.

## PHYSICAL AND ECONOMIC IMPACTS

While most of the projects have multiple-purpose possibilities, it is perhaps most useful to discuss the impact of the projects by their primary purposes. For each major purpose, the physical impact of the project will be discussed, the benefits to national efficiency objectives will be described, and the impact on the regional economy will be estimated.

National efficiency objectives are concerned with expansion of our gross national product or national income, relative to the investment in the projects. Since the Basin plan is being developed by a regional planning body, the impact on the regional economy is estimated to indicate what is at stake in terms of regional development objectives. These may be quite different than national efficiency objectives. The reader is cautioned to keep this distinction in mind when considering the estimates of the different benefits.

Table 8.5. Summary of Physical Impact, Benefits to National Efficiency, and Regional Effects of Proposed Project Developments.

Proposed Project Development	Annual Benefits to National Efficiency (Primary Benefits) (\$1,000)	Regional Effects of Project Installation (\$1,000)	Annual Regional Effects of Project Development (\$1,000)	Physical Impact
Irrigation Projects	842	15,010	1,684	Irrigation 6,400 acres Recreation 385,000 annual visitor days Low Flow Augmen- tation - 7,600 acre feet
Flood Control & Drainage Projects - Tannery Brook Middle & Lower Tonawanda 8/	384 (40) (344)	3,684 (751) (2,933)	688 - (688)	Flood Control & Drainage for 24,000 acres
Recreation Projects	475	6,425	950	315,000 annual visitations
TOTAL	1,701	25,119	3,322	

8/ The impact has been estimated only for the 24,000 acres which could be economically developed under the present flooding conditions of Tonawanda Creek

Criteria used to evaluate the effect of projects relative to national efficiency objectives are concerned only with the net value of the immediate products or services of the projects. The criteria used to evaluate the effect of the projects relative to regional development objectives are concerned not only with the immediate products or services of the projects, but also with the effect these changes in income have throughout the entire regional economy.

It should be kept in mind that when national efficiency benefits and regional development benefits are defined in this manner that they are not additive.

These regional economic efforts can be estimated by the use of multipliers. A fairly large number of studies are available which describe this multiplier effect of regional transactions and estimate the size of these multipliers.<sup>9/</sup> Using these studies and guidelines developed by the Environmental Economics Branch, Natural Resources Economics Division, Economic Research Service, an average multiplier of 2.0 seems appropriate for the Basin. While these regional effects are not valid for testing financial feasibility from a national efficiency viewpoint, they are useful when regional development objectives are considered.

## IMPACT OF IRRIGATION PROJECTS

Irrigation has been practiced for many years in the Basin but has not been widely adopted at this time. Yield and quality improvements have been demonstrated in field experiments and economic studies indicate that it is a profitable practice. Lack of adequate supplies of water is a possible reason for irrigation not being more widely adopted in the Basin but other considerations such as more profitable alternative capital investments (for instance, labor-saving equipment like the mechanical snapbean harvester) may be important factors.

The Basin's regional and national share of vegetable and fruit needs is projected to increase substantially over the next 50 years. Demands by processors for improved quality and product uniformity are expected to increase. Development of irrigation projects could have a significant impact on maintaining or improving the competitive position of growers in meeting the processors' requirements.

A total of about 6,400 acres could be irrigated from seven projects. Benefits from irrigation are estimated in Appendix C. Assuming that the project areas in the aggregate would have the same crop mix as used in estimating these benefits, over \$193,000 would be added to farm incomes annually. The regional impact of this additional income would be about \$386,000.

<sup>9/</sup> A few representative studies are:

Gamble, Hays B. and David L. Raphael, *A Microregional Analysis of Clinton County, Pennsylvania*.

Kalter, Robert J., *An Interindustry Analysis of the Central New York Region*.

Morton, David W., *An Intersector Study of Transactions in a Small Fishing, Farming, and Summer Recreation Region*.

Benefits in these project areas would also accrue from recreation, low flow augmentation and flood damage reduction. Recreation activities of about 385,000 visitor days would provide an estimated \$576,000 in annual benefits; low flow augmentation and estimated \$70,950, and flood damage reduction benefits an estimated \$2,250 for a total of almost \$650,000 annually. The regional impact of this additional income would be about \$1,300,000.

Money spent to install the projects would also leave regional impacts during the installation period. Based on total installation costs of \$7,504,800, impacts would be in excess of \$15 million. The total annual regional impact of additional income would be over \$1.6 million resulting from the total annual primary benefits of about \$842,000.

#### IMPACTS OF FLOOD CONTROL AND DRAINAGE PROJECTS

Project developments on some 24,000 acres of agricultural land in the Middle and Lower Tonawanda would improve yields, facilitate changes in land use and possibly shift crop distribution. Based on the study of Black Creek (Appendix B), farm incomes would be expected to improve about \$344,000 annually as a result of the projects. Regional effects resulting from the project are estimated at about \$688,000 annually. Project installation cost of \$1,464,000 would generate regional effects estimated at about \$3 million during the period of project installation.

The impact cannot be measured for the remaining 16,000 acres in the Middle and Lower Tonawanda which would benefit with projects under future conditions. These future conditions could be created by a Corps of Engineers' flood prevention project on Tonawanda Creek.

Reduction in flood damages to the village of East Aurora estimated at about \$40,000 annually, would result from the installation of the Tannery Brook project. Regional effects would be limited to those accruing from project installation expenditures and are estimated at about \$600,000 during the installation period.

#### IMPACTS OF RECREATION PROJECTS

Five projects have recreation as the primary purpose. They could provide over 315,000 annual visitations valued at almost \$475,000 annually. The regional effects of these sites are estimated at almost \$950,000 annually. The regional effects of expenditures for installation of these projects is an estimated \$6,475,000 during the construction period.

## COORDINATION AND PROGRAMS FOR FUTURE DEVELOPMENT

Many of the potential single purpose developments identified in this report qualify under PL-566 legislation. However, present policy restraints preclude all other purposes except flood prevention as the primary purpose of the project. Secondary purposes such as irrigation, drainage, fish and wildlife, and recreation are possible only if the project satisfies the present primary purpose policy.

In lieu of a change in PL-566 policy, Resource Conservation and Development (RC&D) or other USDA programs may be utilized to develop some of the project recommendations. Also, these recommendations may be initiated and developed by independent, local action programs.

This report has considered meeting Basin needs only through development of small watersheds and related measures. There are several possibilities for development of large multipurpose sites. The extent to which these larger sites alone or in combination with the sites discussed in this report could meet Basin needs is not known at this time.

The Erie-Niagara Regional Water Resource Planning Board has the responsibility of developing a comprehensive water and related land resource plan and to determine the means of implementing such plans. The Board, with the assistance of all participating agencies, has been formulating a plan based upon data contributed by various agencies, including this report, to determine the best alternatives to meet the needs and solve the problems. The following paragraphs describe development potentials which should be considered in both present and future comprehensive planning.

### LAND TREATMENT

Land use planning and the installation of land treatment measures are recommended and need to be an integral part of water resources plans formulated for future development.

### FLOOD PREVENTION

No single purpose flood prevention site was found to be feasible. However, if one of these sites is selected to be constructed for another purpose under other than a USDA program, flood protection could be added

as a secondary purpose. The Tonawanda Creek flood damage could be greatly reduced by a Corps of Engineers type project. This project would create improved conditions in the Lower Tonawanda area and would open the way for more intense agricultural production.

USDA programs cannot provide flood protection for the flood plains delineated on Slate Bottom Creek, Ellicott Creek, and Eighteenmile Creek. However, local governments could provide zoning for these areas to reduce future flood damages and provide wise land use of the flooded areas.

Zoning is also needed on Upper, Middle, and Lower Tonawanda Creek, and Murder Creek.

## IRRIGATION

There are 24 irrigation sites, capable of supplying irrigation water to about 8,700 acres, which were not selected for inclusion in a potential PL-566 plan. The irrigation benefits of each site should be considered if the site is selected to meet another need. Site 148-6 (Linden) could provide needed irrigation water, not only to areas along Tonawanda Creek, but to large areas just north of the Basin boundary near Batavia which are short of supply at the present time.

In some areas wells could be economically developed to supply water for irrigation. Cattaraugus Creek has some excellent ground water sources. Development of wells for irrigation in this area would supply up to about 1,200 gpm at cost ranging from \$20 to \$40 per acre-foot pumped.

Ground water may be a more economical alternative for irrigation than some of the upstream reservoir sites identified. Further studies should investigate the ground water possibilities before the final decision is made to develop the site.

Using data developed by the U. S. Geological Survey, a preliminary analysis was made of the ground water potential at the location of each site identified as feasible for irrigation water supply. The following table shows the apparent ground water possibility at each of these sites.

Ground Water Possibility	Site Numbers	Total
Good	44-22, 23, 27, 59	4
Questionable	44-1, 56, 64; 72-8	4
Poor	1-6, 7; 44-7, 34; 56-11; 148-1; 238-2	7
		<hr/> 15

## AGRICULTURAL DRAINAGE

Although agricultural drainage along Lower Tonawanda area can be improved by channel improvement on the tributaries, full development of the area will not be realized because of the frequent flooding of Tonawanda Creek.

A Tonawanda Creek flood protection plan now under consideration by the U. S. Army Corps of Engineers would offer greatly improved outlet conditions for about 30,000 acres in the Lower Tonawanda area.

It cannot be overstated that this area offers great agricultural potential. The soils are good to excellent for agricultural production and the area is close to the Buffalo market. With 3-5 year frequency flood protection and improved drainage, the incentive for landowners to establish more intensive agricultural use of the land would be greatly enhanced. Implementation of the Corps of Engineers plan should be of vital concern during formulation of a plan for the Erie-Niagara Basin. Zoning the area for agricultural use is an important first step.

## LOW FLOW AUGMENTATION

Forty-eight sites could provide low flow augmentation for waste assimilation. Twenty-eight sites could be multipurpose irrigation sites and five of these are recommended as feasible to be included in a PL-566 project. The remaining 43 sites could be developed through local or state efforts.

## MUNICIPAL AND INDUSTRIAL WATER SUPPLY

Eleven upstream reservoir sites have the potential of supplying over 30,000 acre-feet to areas now short of water supply. Eight of these are also needed for irrigation water supply. These sites should be considered for supplying municipal and industrial water in plan formulation.

## RECREATION AND FISH AND WILDLIFE

At the writing of this report, recreation and fish and wildlife needs had not been established. Therefore, only those reservoir sites located within a recommended USDA project area have been definitely selected

to fit into an overall Basin plan. Technical services and cost-sharing can be provided under PL-566 for an upstream recreation or fish and wildlife reservoir only if that reservoir is included in an authorized flood prevention project.

Of the total number of potential impoundment sites identified in this report, 68 have potential for recreation and 58 for fish and wildlife habitat development. In several cases, sites were identified as having potential for both uses, although in some instances the uses may not be compatible.

## ADDITIONAL AUTHORIZATION

Comprehensive planning being undertaken in the Erie-Niagara Basin under the direction of the Erie-Niagara Regional Water Resources Planning Board is both desirable and necessary. The Board, however, has no means by which to implement its plan and the state and local governments have limited legislation, at this time, to participate in major construction expenditures.

Public Law 566, Public Law 46, Cooperative Forestry Programs and the Resource Conservation and Development Program will provide technical and cost-sharing assistance for measures which primarily involve flood control, irrigation, drainage and land treatment. However, in order to facilitate the portions of the programs dealing with single and multipurpose recreation, fish and wildlife, municipal and industrial water supply, and water quality control, additional authorization may be required to meet future needs.

## RECOMMENDATIONS

The following recommendation could be made at such favorable time that the Regional Board desires the total near future plan to be implemented.

### ADDITIONAL AUTHORIZATION FOR USDA PROGRAMS

It is recommended that the Secretary of Agriculture be authorized to carry out the upstream aspects of the Erie-Niagara Basin Comprehensive Plan which need to be installed to meet needs identified for 1980 with such modifications, thereof as in the discretion of the Secretary of Agriculture may be advisable.

In carrying out this program, it is recommended that the Secretary of Agriculture be authorized to participate in single and multipurpose developments for flood prevention, irrigation, drainage,

water quality control, fish and wildlife developments, recreation, municipal water supply and accelerated land treatment associated with project plans. Federal technical and cost-sharing assistance should be the same as that contained in other existing authorities provided the Secretary.

The Secretary's participation should be based on project plans to be submitted to him by appropriate agencies of the Department of Agriculture. Such plans will be developed only after appropriate applications have been received by the Secretary from qualified local sponsoring organizations and will be consistent with the findings and provisions of this comprehensive plan. The planning and development work will be coordinated with other federal and state agencies. Operation and maintenance of all developments will be the responsibility of local sponsoring organizations.



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PRELIMINARY  
UPSTREAM RESERVOIR STUDIES

APPENDIX A

(Published as a Separate Book )



SPECIAL PROJECT STUDIES

UNDER

USDA PROGRAMS

APPENDIX B

UNITED STATES DEPARTMENT OF AGRICULTURE REPORT

WESTERN NEW YORK RIVER BASINS

ERIE-NIAGARA BASIN

Prepared by

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service   Economic Research Service

Forest Service



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## INTRODUCTION

More than 91,000 acres of agricultural land are affected by inadequate outlets for drainage and floodwater. Historical records, local interviews and hydraulic calculations indicate flooding in the Erie-Niagara Basin is taking its toll from the overall economy. Because these areas are scattered throughout the Basin, total monetary damage determinations are difficult to make.

Total average annual damage is estimated to exceed \$1,500,000. In areas studied by the USDA, floodwater damages of \$102,700 on 22,400 acres were found. Most of the latter damages can be attributed to flooding of agricultural land. Figure B.1 shows the location of the main damage areas studied.

The areas studied in detail are Black Creek, Tannery Brook, Upper Tonawanda Creek and Upper Murder Creek. Special studies to determine the extent of the flood plains were made on Slate Bottom Creek, Ellicott Creek and Eighteenmile Creek. Buffalo Creek was originally studied as a pilot watershed project under the Flood Control Act of 1944 and was not restudied.

As a result of the USDA studies, two potential PL-566 project areas were identified - Black Creek and Tannery Brook. Average annual damages of over \$105,000 were found on more than 4,700 acres. Of the damages, \$38,000 are the result of urban flooding in East Aurora from Tannery Brook.

## PROCEDURES

### SELECTION OF PROJECTS FOR STUDY

At the beginning of the study, a field reconnaissance was made with the Soil Conservation Service district conservationists and the New York State Division of Water Resources personnel, to determine those areas in the Basin which have a concentration of water and related land resource problems, such as flooding, poor drainage, lack of recreational opportunities, or a shortage of irrigation water.

These selected watersheds were investigated in sufficient detail to determine the potential that exists in these watersheds to help solve the problems and needs through PL-566 type watershed projects.

Where it was determined that a project was potentially feasible and should be initiated within 10 to 15 years, a watershed investigation report (WIR) was prepared. When there was no feasible project under existing criteria, a watershed evaluation report (WER) was written. In the Erie-Niagara Basin, two watershed investigation reports and two watershed evaluation reports were prepared.

These reports are prepared to enumerate the needs and problems, to propose solutions, and to evaluate costs and benefits. This information can help the Regional Water Resources Planning Board develop their water resources plan. Further, other interested local organizations will find the report useful in initiating the development of the project in their area.

### INVESTIGATIONS AND ANALYSES

A team made up of several disciplines examined and evaluated the selected watersheds. This provided a more complete and coordinated effort during the study. Disciplines involved and their approach included:

#### ENGINEER

Structural measures designed in the project studies were either water impounding structures or channel improvement. All designs were based on Soil Conservation Service criteria.

Impoundment sites were selected by topographic map studies. Centerlines of selected representative sites were surveyed.

The designed height of the dams and the pool size were governed by one or more of the following factors: (1) the storage volume needed to retard a 100-year frequency storm without discharge occurring in the emergency spillway, (2) the selected beneficial storage volume, (3) the estimated storage volume for 100-year sediment accumulation, (4) limiting topographic or geologic features, (5) allowable release rates, and (6) critical land rights elevations.

Embankment volumes were computed from surveyed centerlines or centerlines plotted from USGS topographic maps. Stage-storage data was computed from USGS 7 1/2 minute topographic maps.

Channel designs were based on surveyed cross-sections of the channel and distances obtained from the USGS 7 1/2 minute topographic maps. Capacity of the channels was based on the requirement to keep a design frequency storm within banks or to provide a drainage outlet.

Unit costs used in estimating the cost of the structural measures are based upon data compiled from recent construction of similar work in New York.

## GEOLOGIST

Geologic investigations of the watersheds consisted of map studies and field investigations. Structure sites and channels were appraised by examining the geologic map of New York State and the appropriate county soil survey report. This information was field checked and occasional soil borings were made with a hand auger to obtain additional information.

A report was prepared indicating site conditions which would need attention in the design stage. Items which would affect the cost, such as rock excavation, permeable sands and gravels, soft foundation, and lack of borrow were evaluated with the engineer and treatment costs established.

Erosion and sedimentation in the watershed was observed to determine if any serious problems existed which should be considered in the project.

## BIOLOGIST

Consideration of the fish and wildlife and recreation aspects was given to all project watersheds by the geologist in cooperation with the New York State Department of Environmental Conservation, Division of Fish and Wildlife. The main role of the Division was to supply information

concerning the classification of the streams within project areas, and the existing fishery resources.

With this information, a field reconnaissance was made by the Soil Conservation Service biologist. Present conditions of the watershed in regards to the fish, waterfowl, and upland wildlife habitat were recorded. Potential sites for fish, wildlife and recreation areas were examined.

Project alternatives were evaluated to see what effect they would have on the resources of the area. Enhancement opportunities and potential damages are appraised in order to properly evaluate project benefits.

## ECONOMIST

The selected watersheds were investigated to determine land use, cropping patterns and damage potentials for agricultural and nonagricultural uses of the flood plain areas. Field examinations, interviews, historical events or synthetic methods were used to obtain data to develop estimates. Average land values for land rights were checked for adequacy. Pertinent trends were identified where possible.

Project benefit evaluations were based on material prepared by other members of the team.

Adjusted normalized prices and crop budget data were taken from the USDA Economics Guide and Regional Technical Service Center technical notes where applicable. On muckland truck crops, the net income method was used to determine damages and benefits.

Costs were allocated to purposes and compared with benefits to determine project feasibility. Alternative measures were considered to find the best solutions to the problems encountered.

## HYDROLOGIST

Hydrologic and hydraulic studies were conducted where expressed water problems existed in agricultural or urban areas.

Channel and valley cross-sections were surveyed to USGS datum to define flow areas and to obtain elevations of physical developments in the flood plain. Stage-discharge relationships for each section were computed by use of a water surface profile computer program. The procedure is based on the assumption of steady flow where the discharge through each section remains constant for the time interval under consideration.

Frequency discharge relationships were obtained using USGS gage records where available. The frequency discharge relationships were based on the annual series and determined by the Log Pearson Type III distribution. For those areas where gage data was not available, procedures outlined in

SCS-TP-149, *A Method for Estimating Volume and Rate of Runoff in Small Watersheds*, was used for drainage areas less than 2,000 acres. For larger areas, a computer program, *Project Formulation - Hydrology*, SCS-TR-20 was used.

The effects of proposed structural works of improvement were analyzed by determining the reduction in peak flow through damage reaches.

Soil Conservation Service policy and procedures were used in all computations.

## SOIL SCIENTIST

Prepared the Basin soil association map and manuscript which has been issued as a separate publication, *General Soil Areas of the Erie-Niagara Basin*.

With the assistance of local district conservationists, land use and conservation problems and needs were identified on agricultural and other open lands. Erosion and drainage problems were located. Costs of land treatment measures on cropland and pasture were estimated from the Conservation Needs Inventory data.

Land currently irrigated was identified with the help of district conservationists and extension agents. Interviews with local irrigators indicated sources and adequacy of water supplies.

Irrigable lands were defined and the locations delineated on 7 1/2 minute topographic quadrangles.

Correlating land use and soil association information, hydraulic curve numbers were computed.

## FORESTER

Field surveys of the watersheds were made to obtain information on the hydrologic condition of the forest land, and the reasons for the present hydrologic conditions. This information serves as the basis for forest resource problems and needs in rural and urban areas.

Information was obtained as to percent of the land in forest cover, location, ownership patterns, condition, and use of this land. Problems on forest land which relate to flooding, erosion, sedimentation and the hydrologic condition of the land were identified.

This information was then evaluated to determine what treatments are needed to improve the land to meet its hydrologic potential. Areas for potential forest recreation sites and wildlife habitat development were screened. Land treatment measures and their effects on the forest lands were determined.

## REVIEWS

In order to provide the maximum possible protection with the least costly solution, all plans are formulated by the team members involved in the project. These members carefully review the final plans and the report is distributed for review to other USDA agencies, Soil Conservation Service field personnel and those staff members who work on allied programs. This procedure serves to get the best possible report and to keep others abreast of work being accomplished under River Basin programs.

## USE OF REPORTS

These reports are intended to be a summary of all information available for a particular problem area. The compilation of the information and orderly presentation provides a report which can be used in a request for planning authorization under the Public Law 566 program. It also will provide a useful tool to the Regional Water Resources Planning Board who is preparing a comprehensive plan for the orderly development of the water resources of the Erie-Niagara River Basin.

TANNERY BROOK WATERSHED INVESTIGATION REPORT

TRIBUTARY OF BUFFALO CREEK - WATERSHED NO. 1

Western New York Type IV River Basins

Erie-Niagara Basin

Erie County, New York

December 1969

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service   Economic Research Service   Forest Service



# TANNERY BROOK WATERSHED INVESTIGATION REPORT

## ERIE-NIAGARA BASIN

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## PREFACE

Selected watersheds are investigated under River Basin Authority in sufficient detail to determine the potential that exists in these watersheds to help solve the water and related land resource problems and needs through PL-566 type watershed projects.

Where it is determined that a project is potentially feasible and should be initiated within 10 to 15 years, a watershed investigation report is prepared. Tannery Brook in the Erie-Niagara Basin was determined to be a potential PL-566 project.

The Tannery Brook Watershed Investigation Report is prepared to enumerate the needs and problems, to propose solutions, and to evaluate costs and benefits. This information can help the Erie-Niagara Regional Water Resources Planning Board develop their water resources plan. Further, the village of East Aurora trustees and other local organizations will find the report useful in initiating the development of Tannery Brook.

TANNERY BROOK WATERSHED INVESTIGATION REPORT  
Tributary of Buffalo Creek - Watershed No. 1  
Western New York Type IV River Basins  
Erie-Niagara Basin  
Erie County, New York

December 1969

THE WATERSHED IN BRIEF

Tannery Brook is a subwatershed of Conservation Needs Inventory, CNI Watershed No. 1, Buffalo Creek, and is designated as Watershed Number 1-A. It is located in the town of Aurora, county of Erie in Western New York State about 20 miles southeast of Buffalo. According to the 1960 census, 6,791 of the 12,888 town of Aurora residents live in the village of East Aurora.

Tannery Brook is approximately 4 miles in length and has a total drainage area of 2.8 square miles. The flow is in a westerly direction from its headwaters through the village of East Aurora to its confluence with the East Branch of Cazenovia Creek. However, with the planned diversion of floodwater to Buffalo Creek, the drainage area for the proposed project increases to 5.2 square miles. See Figure 1.

The watershed is located on the boundary of Land Resource Areas L-101 and R-140. LRA L-101 is the Ontario-Mohawk Plain of the Lake States Fruit, Truck, and Dairy Region and LRA R-140 is the Glaciated Allegheny Plateau and Catskill Mountains of the Northeastern Forage and Forest Region. The area is characterized by rolling topography. Present land use is estimated to be 5 percent cropland, 35 percent grassland, 15 percent forest, 30 percent idle and 15 percent urban. Each year, these figures change as dairying decreases with the trend to rapid urbanization of the watershed.

All forest land is privately-owned. Forest stands are predominantly hardwood - the principal type is elm-ash-red maple. Several small softwood plantations are located in the watershed. Forest land is generally in fair hydrologic condition.

The upper portion of the watershed has glacial till soils that are two to four feet to shale bedrock. The lower part of the area has glacial outwash soils.

WATERSHED PROBLEMS AND NEEDS

Land Treatment

Land use in the watershed is changing rapidly from dairy agriculture to urbanization. Land treatment for the areas remaining in agriculture is needed to improve soil structure and increase yields and quality of crops. Land in transition to urban development is generally idle and adequately protected by weeds, grasses, and trees. However, technical assistance and land treatment practices are needed during all stages of urban development.

2.

### Floodwater

The principal floodwater damage is to an area in the village of East Aurora. The major portion of the damage is confined to residential properties.

Flooding by Tannery Brook is due to discharges in excess of the channel capacity and ice jams which retard the normal channel flow.

In some sections, the channel capacity is reduced by excessive growth of trees and bushes. In other sections, there are many encroachments such as garages, collapsing retaining walls and low foot bridges. Several of the bridges over the creek are of inadequate capacity and restrict flow with or without ice jams. These conditions have produced frequent damaging floods.

The March 1955 flood, estimated to be a 20-year frequency, was used as a guide to delineate the approximate 100-year flood plain as shown in Figure 2. There were approximately 40 acres inundated from the 1955 storm. A damage survey of this storm indicates a repetition of the March 1955 flood would result in damages of \$30,000 based on 1966 price levels. Seventy residential and eight commercial properties would be affected. Some of the residential properties are outside the March 1955 flood outline. Damage on these properties is due to storm sewer backup caused by the overflow. Average annual damages were estimated to be \$38,000.

### Erosion and Sediment

Although there are some minor streambank scouring problems, it is not recognized as a significant problem in this watershed. Sheet erosion is not a serious problem. Areas undergoing extensive disturbances during urban development and highway construction have a high erosion hazard. Such areas contribute a disproportionately large share of stream sediments.

### Agricultural Water Management

There are no major agricultural water management problems in this watershed. No extensive areas of flat, wet soils requiring drainage through group action exists. All drainage problems can be solved with individual on-farm systems. The need for supplemental irrigation is not anticipated. Water management practices such as diversions, to control runoff and erosion, improve soil structure, increase yields of livestock supporting crops, and the development of water supplies for livestock are all that are needed.

### Nonagricultural Water Management

The nonagricultural water management problems are related to the needs and desires of the urban population. The prime management concern is urban land use planning, zoning regulations, and development not only on the flood plain, but also on the upland areas of the watershed. There is a limited opportunity for water management for fish and wildlife and recreation in the Tannery Brook Watershed. These needs will have to be

met by developments in other areas of the Erie-Niagara Basin. No specific development for municipal and industrial water is needed in Tannery Brook as the East Aurora village and the Erie County Water Authority supplies can adequately meet future needs.

### PHYSICAL POTENTIAL FOR MEETING NEEDS

The three following possible potentials to reduce damaging floods on Tannery Brook have been investigated at different times by various interests:

Potential Solution 1 - Construct a diversion channel from a point approximately 450 feet north (downstream) from the Route 20A bridge to the existing channel (tributary to Buffalo Creek) north of West Blood Road. The amount of water entering Tannery Brook is to be regulated by the construction of a structure at the point where this diversion channel starts. This structure will be designed so that flows exceeding the existing channel capacity of Tannery Brook within the village of East Aurora would be diverted to the diversion channel.

Normal within channel flows would continue to flow in the existing channel through the village. Some channel improvement and bridge enlargements would be required on Tannery Brook to remove obstructions and stabilize eroding banks. This solution was recommended by the Soil Conservation Service in the 1956 work plan for Cazenovia Creek subwatershed of the Buffalo Creek watershed project. This is the most feasible solution at the present time.

Potential Solution 2 - Enlarge the existing channel bridges and conduits through the village of East Aurora to accommodate the flood flows. This study was made by the village through the services of a private engineering firm in 1960. The study concluded that total channel improvement cost for 10-year protection would be \$486,000 and would be \$1,700,000 for 50-year protection.

Potential Solution 3 - Improve the existing channel within the village and construct flood control reservoirs at the headwaters of Tannery Brook. Two possible reservoir sites were located about 1-1 1/2 miles above East Aurora. They would control about 45 percent of the watershed which would not eliminate the need for extensive channel improvement or a diversion. This possibility was found to be too expensive for the benefits received.

A site offering more floodwater reduction was located about 400 feet above New York State Route 20A. This site would control about 70 percent of the drainage area. The estimated cost is \$800,000 with a top of dam at elevation 998. A portion of Route 20A would have to be relocated to construct the site.

The possibility of utilizing the proposed expressway as a floodwater retarding dam was also studied. This was found to be impractical due to excessive modification cost in addition to the problem created by the planned Route 20A underpass adjacent to where Tannery Brook will pass under the

4.

The Department of the Army, Corps of Engineers, Buffalo District, also studied these possible solutions plus diking.

No obstacles exist for land treatment on either agricultural or urban land uses. The Erie County Soil and Water Conservation District program of assistance to landowners in land use planning and conservation treatment can meet present and future needs.

The forest land has a medium potential to improve hydrologically. There are few forested areas having natural restrictions such as shallow soil, lack of fertility and moisture, or excessive slope or water that limit hydrologic improvement.

#### LOCAL INTEREST IN PROJECT DEVELOPMENT

The village board of East Aurora has recently expressed great interest in the possibility of a PL-566 project on Tannery Brook.

Two important steps are necessary before a meaningful PL-566 application could be submitted. These are listed as follows:

1. Adequate assurance of flowage rights for the diversion of floodwater from Tannery Brook to Buffalo Creek.
2. Arrangement for the installation of a culvert to carry 1300 cfs flood flow under the proposed Aurora Expressway. This would be in addition to the culvert already planned at the same location.

The watershed is in the Erie County Soil and Water Conservation District. When the diversion project was first proposed in 1956, the district was interested in sponsoring such a project.

#### WORKS OF IMPROVEMENT FOR POTENTIAL DEVELOPMENT

##### Land Treatment -

The land treatment program in this watershed emphasizes proper land use, and the application of conservation practices to protect and improve farmlands, forest lands and to improve overall farming efficiency.

The main agricultural enterprise in the watershed is dairying. Recommended conservation practices on cropland include conservation cropping systems, cover crops, diversions, open drains, grassed waterways, random tile drains, and stripcropping. On grassland practices such as pasture and hayland planting and renovation, rotation grazing, farm ponds, and fencing to exclude livestock are suggested.

Fire is not a serious problem on the forest land at present, but continued protection is basic and essential to derive the maximum benefits from all watershed protective measures. Logging roads and skid trails should be properly located.

Land use adjustments from agriculture to urbanization are being made. During future residential or urban development, conservation practices need to be applied during construction to reduce soil erosion and siltation in the stream. Such areas need cover crops, critical area planting, debris basins, diversions, grassed waterways, grade stabilization structures, mulching, sodding, vegetative barriers, or water spreading.

Technical assistance will be needed by local planning and zoning boards, and other community leaders to assist them in land use planning and zoning, and the development of planned facilities for the entire watershed. Such assistance is needed to retain an optimum amount of vegetative cover on open and forest areas being planned for residential, industrial and park use.

Assistance can also include the identification of buffer and infiltration zones and sediment trapping areas to be left in natural cover. Further technical assistance can be provided to developers for on-site plans to minimize the deterioration of the hydrologic balance and resulting erosion by the maintenance of vegetative cover on open and forested areas during development. Urban developers will be encouraged to utilize the natural landscape in their planning.

Technical assistance is available from agencies of the U.S. Department of Agriculture, the State of New York, the County of Erie, and the Erie County Soil and Water Conservation District.

#### Structural Program -

The results of investigations by both the Corps of Engineers and the Soil Conservation Service conclude that the most economical plan includes the diversion of floodwater and channel improvement as shown in Figure 3. This is the same recommendation made in the 1956 work plan for Cazenovia Creek.

Under the proposed diversion, low flows up to 86 cfs would pass down the existing Tannery Brook channel. About once every two years flows greater than this will occur and the excess would be diverted into Buffalo Creek.

The diversion channel is designed to be a trapezoidal section with a 35-foot bottom width and side slopes of 2:1 for a distance of about 3,000 feet. It is designed to carry 1300 cfs (100-year frequency flow) at a velocity of 6.0 feet per second through a channel cut into shale.

One 36-inch culvert under the diversion dam would carry the low flow to the natural stream and a concrete weir in the new channel would regulate the high flows. A dike on the west bank of the diversion would protect low areas immediately downstream of the diversion.

In addition to the existing culvert, a 108-inch diameter culvert (or equivalent) would be required to pass the diverted flows under Porter-ville Road in the Buffalo Creek watershed. Also, an additional 132-inch diameter culvert (or equivalent) would be required to pass the 1300 cfs diverted flood flows under the proposed Aurora Expressway. The design

and cost of these culverts should be more firmly established by the New York State Department of Transportation in any further planning studies.

In addition to the diversion system, channel improvement will be necessary on Tannery Brook from the eastern village limits to Oakwood Avenue. This channel improvement involves widening the channel in places, sloping the banks, riprapping the banks where necessary, and removing debris and trees in the channel. Table I details the structure data.

The bridge at North Grove Street is undersize and deteriorating and should be replaced. The conduit under Main Street contains several utility pipes which cause obstruction to flows and it is suggested that consideration be given to relocating these pipes.

The natural stream expected to carry the diverted flood flows from the expressway to Buffalo Creek is generally stable and adequate. Some channel shaping and vegetative planting would be needed to assure stable conditions and ease in maintenance.

#### NATURE AND ESTIMATE OF COST OF IMPROVEMENTS

Technical data developed for the 1956 Cazenovia Creek work plan was used as the basis for all designs and cost estimates. This data was modified, where necessary, to adequately represent present conditions in the watershed and to meet current design criteria and price levels. The cost of the additional culvert under the proposed Aurora Expressway was estimated as being installed at the same time as the expressway was being constructed, therefore, it was not considered a project cost.

Existing maps used to develop quantity and cost estimates are as follows:

1. Soil Conservation Service topographic map of diversion channel and dam - 2-foot contour interval, 1"=50 ft. horizontal scale - prepared during Cazenovia Creek work plan investigation in 1956.
2. New York State Department of Transportation map of proposed Aurora Expressway. Horizontal scale 1"=200 ft., prepared in 1965.
3. 7 1/2 minute USGS quadrangle sheets were used to establish physical data on possible upstream reservoir sites.

Construction cost for all structures considered are based upon recent contract cost of similar PL-566 projects in New York.

Table II shows the estimated structural cost of potential development. A 20 percent contingency allowance was added to the estimated construction cost. Engineering services are estimated at 9 percent; administration of contracts at 2 percent, and project administration at 18 percent of the construction cost. Land rights costs were estimated by observation in the field and by information shown on maps on file in the Soil Conservation Service State Office.

TABLE I - STRUCTURE DATA  
Tannery Brook Watershed, Erie-Niagara Basin

Channel Designation	Length of Reach (ft.)	Watershed Area (sq.mi.)	Needed Channel Capacity (cfs)	Bottom Width (ft.)	Depth (ft.)	Velocity in Channel (ft./sec.)	Excavation Concrete (cu.yds.)	Estimated Volume Fill
Diversion Channel	3,000	2.3	1,300	35	5.4	6.0	42,600	-
Main 1/ Channel	9,000	2.8	400	-	-	-	7,500	-
Diversion Structure	-	2.3	1,300	-	-	-	-	116
Diversion 2/ Dike	1,500	-	-	-	-	-	-	16,500

1/ The main channel will be riprapped and excavated at various sections, to insure ample capacity to carry storm flows from the watershed area below the diversion.

2/ Located along the west side of diversion channel.

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TABLE II - ESTIMATED STRUCTURAL COST-POTENTIAL DEVELOPMENT

## Tannery Brook Watershed, Erie-Niagara Basin

Item	: : Unit :	Amount Planned	: : Estimated Total Cost (Dollars) <u>1/</u>
STRUCTURAL MEASURES			
Construction			
Diversion Structure	No.	1	19,100
Diversion Channel & Dike	Mi.	0.6	89,200
Main Channel Improvement	Mi.	1.7	59,500
Subtotal Construction			167,800
Engineering Services			15,100
Project Administration			30,200
Land Rights <u>2/</u>			76,700
Administration of Contracts			3,400
TOTAL STRUCTURAL MEASURES			293,200

1/ Price Base: 1967.2/ Includes bridge enlargements and additional culvert.

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Table III shows the installation cost distribution of funds between PL-566 and nonfederal sources, and Table IV shows the cost allocation of the funds.

The annual cost including the cost of operation and maintenance is given in Table V.

#### EFFECTS AND ECONOMIC FEASIBILITY OF POTENTIAL DEVELOPMENT

Table VI compares the average annual benefits from damage reduction and other secondary benefits against the average annual costs. This comparison shows a favorable benefit-cost ratio of 2.5:1.0 for the proposed project.

Land treatment and the installation of structural measures will directly benefit the owners of 70 residential and eight commercial properties. Damage to streets and bridges in the flood plain will be eliminated.

At present there are four residential and two commercial sites available for development. Benefits to future development will be minor.

Since the diversion structure and diversion channel will divert the out-of-bank flows from Tannery Brook into Buffalo Creek, the effect of this on Buffalo Creek was measured. It was determined this diversion would have little effect by increasing the peak flows on Buffalo Creek. However, when this design for controlling flooding on Tannery Brook was submitted as a part of the Cazenovia Creek subwatershed of the Buffalo Creek Watershed in 1956, opposition developed that the Tannery Brook sponsors did not overcome.

#### ALTERNATE OR ADDITIONAL POSSIBILITIES

In addition to the diversion plan recommended in this report, two other potential solutions exist. One solution is to increase the capacity of bridges and conduits through the village of East Aurora. The other includes improving the existing channel and constructing flood control reservoirs at the headwaters of Tannery Brook. Neither solution is as feasible as the diversion plan. During the course of the many studies of Tannery Brook, no other reasonable possibilities were found.

TABLE III - DISTRIBUTION OF STRUCTURAL COST-POTENTIAL DEVELOPMENT

## Tannery Brook Watershed, Erie-Niagara Basin

1/  
(Dollars)

Structural Measures	Installation Cost				
	: :Construction:Services	:Engineering: :Project	:Land : Administration: :Rights: of Contracts :	TOTAL	
Diversion Dam	19,100	1,700	3,400	400	24,600
Diversion Channel & Dike	89,200	8,000	16,000	56,700	171,700
Main Channel Improvement	59,500	5,400	10,800	20,000	96,900
TOTAL	167,800	15,100	30,200	76,700 <sup>2/</sup>	293,200 <sup>3/</sup>

1/ Price Base: 1967.

2/ Includes \$20,000 for bridge enlargements, and \$34,200 for the Porterville Road culvert.

3/ Not included is a non-project local cost of \$221,300 for the culvert under the Expressway.

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TABLE IV - COST ALLOCATION AND COST-SHARING SUMMARY

## Tannery Brook Watershed, Erie-Niagara Basin

1/  
(Dollars)

Item	Cost Allocation		Cost Sharing			
	Purpose		Public Law 566		Other	
	Flood Prevention	Total	Flood Prevention	Total	Flood Prevention	Total
Diversion Dam	20,800	20,800	20,800	20,800	-	-
Diversion Channel & Dike	153,900	153,900	29,200	29,200	56,700	56,700
Main Channel Improvement	84,900	84,900	64,900	64,900	20,000	20,000
Subtotal	259,600	259,600	182,900	182,900	76,700	76,700
Project Administration		33,600		30,200		3,400
GRAND TOTAL	259,600	293,200 <sup>3/</sup>	182,900	213,100	76,700 <sup>2/</sup>	80,100

1/ Price Base: 1967

2/ Includes \$20,000 for bridge enlargements, and \$34,200 for Porterville Road culvert.

3/ Not included is a non-project local cost of \$221,300 for the culvert under the Expressway.

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TABLE V - ANNUAL COST  
Tannery Brook Watershed, Erie-Niagara Basin  
(Dollars)<sup>1/</sup>

Evaluation Unit	:Amortization of <sup>2/</sup> :Installation Cost	:Operation and Maintenance Cost:	Total
Diversion Dam	12,760	1,500	14,260
Diversion Channel & Dike			
Main Channel Improvement			
Project Administration	1,650	-	1,650
GRAND TOTAL	14,410	1,500	15,910

<sup>1/</sup> Price Base: Installation 1967, O&M Adjusted Normalized.

<sup>2/</sup> 100 years at 4 7/8 percent interest.

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TABLE VI - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Tannery Brook Watershed, Erie-Niagara Basin

(Dollars)

Evaluation Unit	: AVERAGE ANNUAL BENEFITS <u>1/</u> :			Average : Benefit	
	:Damage :	:	:	:Annual :	: Cost
	:Reduction:	Secondary:	Total	:Cost 2/:	Ratio
Diversion Dam	38,000	1,900	39,900	14,260	2.8:1
Diversion Channel & Dike					
Main Channel Improve- ment					
Project Administration	-	-	-	1,650	-
GRAND TOTAL	38,000	1,900	39,900	15,910	2.5:1

1/ Price Base: 1967.2/ From Table V.

December 1969

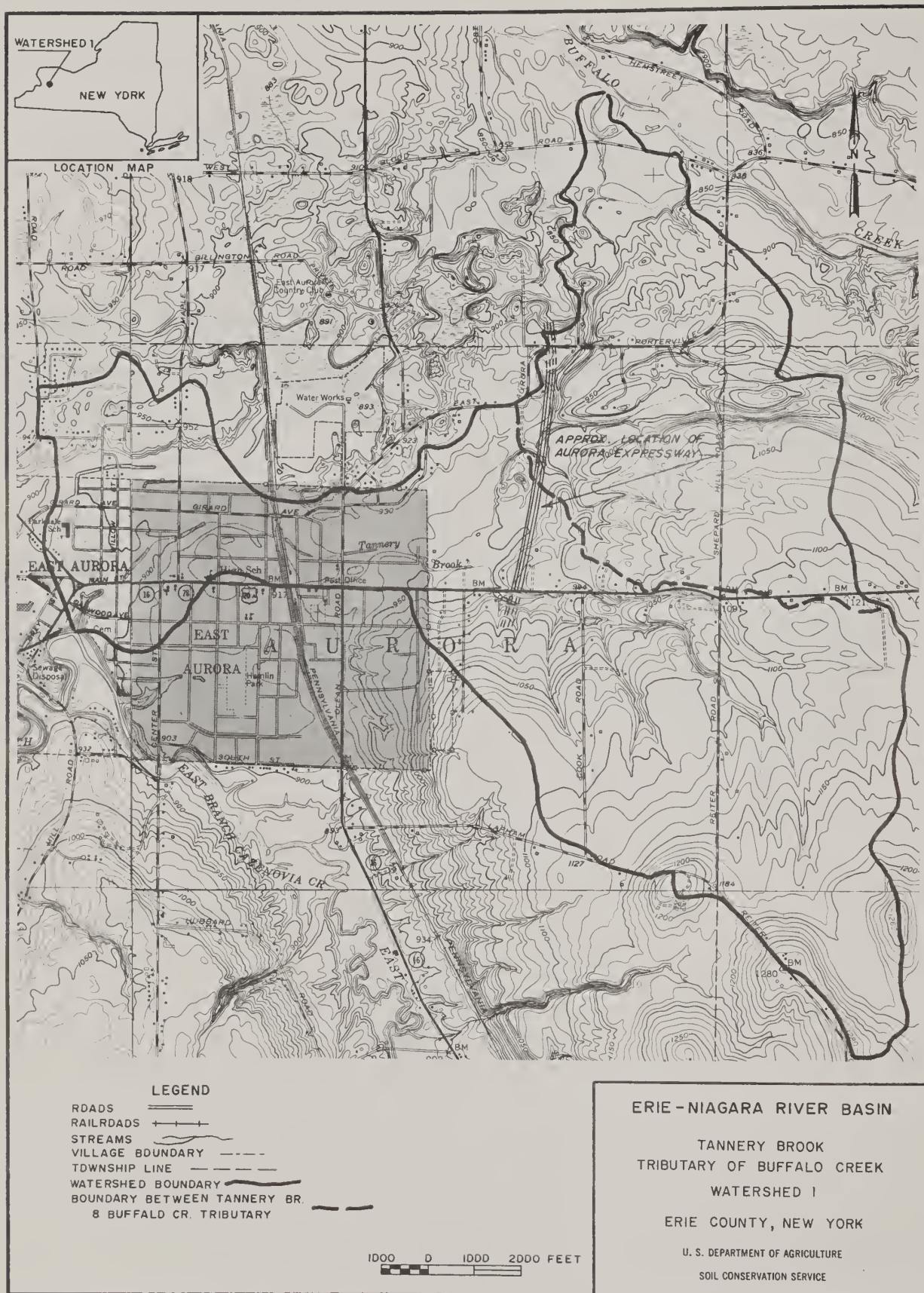


FIGURE 1

# LEGEND

OUTLINE OF APPROX. 100 YEAR FLOOD

VILLAGE LIMITS

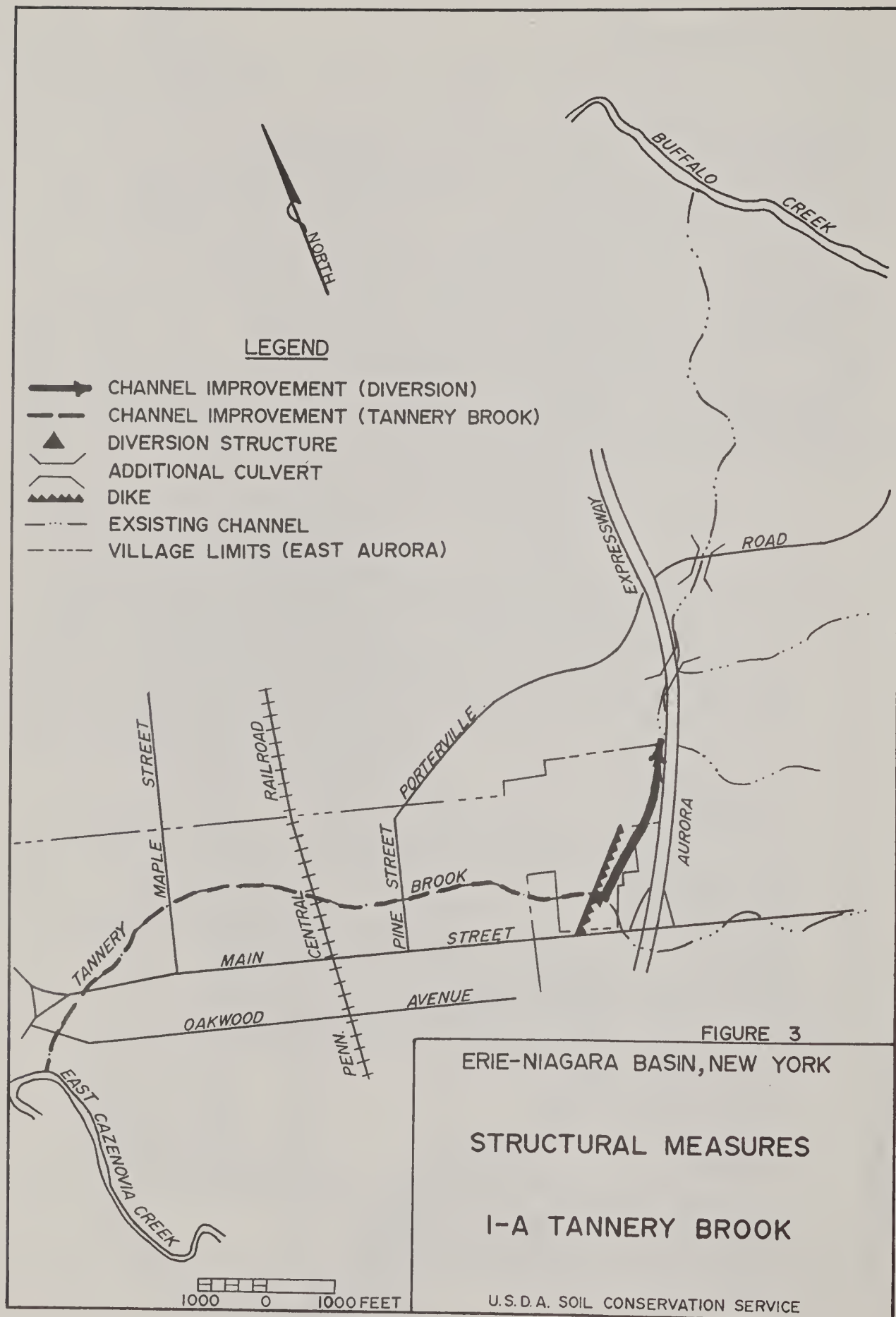


FIGURE 2

ERIE-NIAGARA BASIN, NEW YORK  
POTENTIAL PROJECT DEVELOPMENT  
I-A TANNERY BROOK

Map Taken From a U.S. ARMY ENGINEER  
DISTRICT, BUFALO Report Dated 1967

SOIL CONSERVATION SERVICE



BLACK CREEK WATERSHED INVESTIGATION REPORT  
TRIBUTARY OF RANSOM CREEK - WATERSHED NO. 241

Western New York Type IV River Basins  
Erie-Niagara Basin

Erie County, New York

September 1969

UNITED STATES DEPARTMENT OF AGRICULTURE  
Soil Conservation Service   Economic Research Service   Forest Service



# BLACK CREEK WATERSHED INVESTIGATION REPORT

## ERIE-NIAGARA BASIN

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## PREFACE

Selected watersheds are investigated under River Basin Authority in sufficient detail to determine the potential that exists in these watersheds to help solve the water and related land resource problems and needs through Public Law 566 type watershed projects.

Where it is determined that a project is potentially feasible and should be initiated within 10 to 15 years, a watershed investigation report is prepared. Black Creek in the Erie-Niagara Basin was determined to be a potential Public Law 566 project.

One of the tasks of the Erie-Niagara Basin study is to recommend the best use of the flood plain. The cost of adequately reducing the floodwater and drainage problems associated with urban development on the flood plain of Black Creek would be excessive. Agriculture, therefore, is considered the best land use on the flood plain and this report reflects the measures needed to meet its full potential.

The Black Creek Watershed Investigation Report is prepared to enumerate the needs and problems, to propose solutions, and to evaluate costs and benefits. This information on the agricultural potential can help the Erie-Niagara Regional Water Resources Planning Board develop their water resources plan. Further, other interested local organizations will find the report useful in initiating the development of Black Creek.

BLACK CREEK WATERSHED INVESTIGATION REPORT  
Tributary of Ransom Creek - Watershed No. 241  
Western New York Type IV River Basins  
Erie-Niagara Basin  
Erie County, New York

September 1969

THE WATERSHED IN BRIEF

Black Creek is a subwatershed of Ransom Creek, Conservation Needs Inventory 241 (CNI), and is designated as watershed No. 241-A. It is located in the towns of Clarence and Amherst in Erie County, as shown on the attached map. It has a drainage area of approximately 12 square miles which enters Ransom Creek 2 miles southwest of Millersport. Ransom Creek continues for 2.5 miles in a northwest direction to enter the Tonawanda Creek 2 miles southwest of Pendleton.

The topography is relatively flat in the northern two-thirds of the area and gently sloping in the southern one-third. Soils in the southern one-third are mainly of glacial till origin, while those of the northern two-thirds are lake-laid sediments of silt, sand, and clay. These lake-laid soils are somewhat poorly drained. In the town of Clarence Soil Interpretation Report, map Number 2 shows the general soil areas, and the enclosed insert provides a more detailed soils map. The underlying bedrock is shale.

Black Creek is in Land Resource Area (LRA) L-101, the Ontario-Mohawk Plain of the Lake States Fruit, Truck and Dairy Region. Crops grown are corn, wheat, and cabbage, but hay and idle land comprise the largest acreage. A field study of the watershed showed the land use distribution to be 26 percent cropland, 14 percent grassland, 13 percent forest, 40 percent idle and 7 percent other.

All forest land is privately owned. Most of the larger acreages of forest land is in the upper part of the watershed. In this part of the watershed, the Clarence Center Rod and Gun Club own approximately 250 acres of forest land that is managed as a hunting preserve. The forest land is predominantly hardwood - principal types are ash-elm-red maple and oak-hickory. There are a few softwood plantations in the upper part of the watershed. Forest products consist of small quantities of sawlogs and firewood.

Some urban pressure is being experienced in the general area as a result of its proximity to the city of Buffalo.

WATERSHED PROBLEMS AND NEEDS

Floodwater

Protection from flooding is necessary on cropland in the area. The effect of flooding is even more severe since inadequate drainage is present on a major portion of the watershed. The soil potential of the watershed is

2.

relatively underdeveloped. The flood plain is generally in low intensity land use or idle. The monetary damages to agriculture were evaluated in field surveys. Because little development has occurred in the benefited area, damages of a residential and urban nature were not considered significant at this time.

### Erosion and Sediment

Erosion is not a serious problem on open or forested areas. The flat topography in the area results in little erosion. The very few areas of deposited sediment are not considered significant.

### Agricultural Water Management

This watershed has a severe drainage problem which limits the production and yields of agricultural crops. The preponderance of soils in the Soil Conservation Service capability subclass IIIw indicates the severity of the problem. Adequate drainage is needed and, if provided, significant increases in agricultural yields can be expected.

Under an intensive level of agricultural cropping and management, irrigation may be a future need.

### Nonagricultural Water Management

Urban development in the general area is progressing rapidly. However, there has been little urban development within the flood plain and flat land area of the watershed. There are several limitations that should be considered before urban development is considered for the watershed. These limitations are:

- a. An acute drainage problem exists because of the level topography.
- b. A seasonal high water table.
- c. The substratum is composed of permeable very fine sands which results in poor stability.
- d. Storm drainage systems are presently non-existent and it will be extremely difficult to provide adequate drainage protection for urban development in the area.

These limitations can result in numerous problems for the uninformed. Some of these problems are:

- a. Wet or damp basements.
- b. Cracked basements caused by soil and water pressure.
- c. Inadequate sewage disposal.
- d. Additional expenditures for assuring a good foundation.

Except for small on-farm development, there is little possibility for fish, wetland wildlife, and water-based recreation development in the watershed. These interests will have to be served by developments in other sections of the Erie-Niagara Basin.

The development of municipal and industrial water is unlikely as this area can best be served by the Erie County Water Authority.

### PHYSICAL POTENTIAL FOR MEETING NEEDS

To solve the floodwater and drainage problems in this watershed, the solution requires more extensive development than on-farm drainage measures. Channel and lateral ditch improvement will be necessary to provide adequate drainage for large acreages of agricultural land suffering from excess water. Many of the flood and drainage problems are created by inadequate size of tributary creeks and channels and could be greatly reduced by channel enlargement.

There are numerous channels now in existence in the area, but through siltation, vegetative growth and obstructions, they have become ineffective. In addition, to some new construction, improvement of existing facilities will be required throughout the area. To realize the potential of this program, two developments must materialize. These are:

1. The construction of the Department of Army, Corps of Engineers' flood protection project for Tonawanda Creek which is currently in the planning phase, and
2. The desire of the local landowners to change to a more intensive agricultural land use once the flood threat is removed.

The need for control of erosion and sediment damage by forest cover improvement is very minor and limited to small areas. The potential for the forest land to improve hydrologically is high.

Flood plain regulation can serve as a tool in restricting urban development on this area, because drainage improvement will not be sufficient to allow urban development without significant damages.

### LOCAL INTEREST IN PROJECT DEVELOPMENT

This watershed is in the Erie County Soil and Water Conservation District. The district has not expressed an opinion concerning this project. Some local farmers and homeowners are in favor of such a project, but a united positive view has not been voiced at this time.

### WORKS OF IMPROVEMENT FOR POTENTIAL DEVELOPMENT

#### Land Treatment

The agriculture in this watershed is relatively underdeveloped. To realize the full potential of the soils, a high level of management in agronomic, cultural, and land treatment measures will be needed.

The land treatment needs all relate to drainage. To solve these needs, the first requirement is to install the group drainage facilities as detailed in the structural program recommended in this report. After outlets are available, on-farm treatment may include the following: tiling, open ditches, land grading, bedding, pump systems, and water control structures.

In conjunction with a more intensive agriculture, there is a good wildlife habitat development potential for pheasants. The prime need is for strategically located clump plantings of conifers for winter cover.

Fire is not a serious problem on the forest land, but continued protection is basic and essential to derive the maximum benefits from all watershed protective measures. Hydrologic stand improvement and intermediate cuttings are needed in most of the larger pole and poor sawtimber stands to improve stand vigor and growth, and to favor a residual stand of valuable commercial trees and soil building species. Several small areas of idle land are in need of tree planting. Some idle farm land has revegetated naturally to trees.

On land to be used for urban purposes, land treatment measures are essential. Some of the problems have been enumerated in the section on nonagricultural water management. The town of Clarence and community planners will find the town of Clarence Soil Interpretation Report very helpful in planning various alternative solutions for the specific problems enumerated.

Technical assistance will be needed by local planning and zoning boards, and other community leaders to assist them in land use planning and zoning, and the development of planned facilities for the entire watershed. Assistance of this type is needed to retain vegetative cover on open and forest areas being planned for residential, industrial, and park use. Assistance can include the identification of buffer zones to be left in natural open and forest cover for the benefit of the community. Technical assistance can be provided developers for on-site plans to minimize the urban land and water resource problems.

Technical assistance is available from agencies of the United States Department of Agriculture, the State of New York, the County of Erie, and the Erie County Soil and Water Conservation District.

#### Structural Program

The purpose of the Black Creek project is to provide more adequate drainage to protect cropland from damage caused by flooding. The structural program proposed is dependent on the Department of Army Corps of Engineers' project providing a decrease in the flood threat and better drainage outlet conditions on Tonawanda Creek. Without the Corps of Engineers' project on Tonawanda Creek, the Black Creek project will not function properly to solve the existing floodwater and drainage problem.

With the prospect of a Corps of Engineers' project, factors governing water surface elevations below this project were considered in the design.

Channel improvement is proposed on Black Creek from Station 183+50 at Smith Road to Station 44+00 at Goodrich Road. See attached map. This improvement involves about 5.0 miles of channel enlargement and some channel realignment to eliminate meanders. Cleanout is needed at all bridges and riprap will be installed where abutments are endangered.

Approximately 11.0 miles of lateral channels are required to provide drainage outlets to farms located away from the main Black Creek channel.

Table I shows the design detail of the proposed channel improvement.

#### NATURE AND ESTIMATE OF COST OF IMPROVEMENTS

Field surveys were conducted on Black Creek and some laterals that were considered typical of those in the area. Bridge measurements and culvert openings were also obtained. Cross-sections were surveyed at representative locations and were related to MSL and noted on USGS quadrangle sheets. Distances used in this design were scaled from the topographic maps, and the stationing was derived accordingly. Excavation quantities were calculated from plotted cross-sections.

Design capacities are based upon the "C" drainage curve found in Section 16 of the SCS National Engineering Handbook. Bridge and culvert openings were considered in relation to design capacity and hydraulic gradient. The 20-40 rule was applied in combining lateral flows. Channel capacities are based on Manning's Equation, and limiting design velocities were determined for each channel. These velocities are based upon the particular soil types as obtained from the county soils map and information found in the Soil Conservation Service "Drainage Guide for New York, 1962".

Cost estimates were made separately for Black Creek and the representative laterals. The cost computed for the representative laterals was used to estimate the cost of all laterals. The items included and their unit cost are: excavation, including spreading spoil \$0.80 per cubic yard and riprap \$25.00 per cubic yard.

Cost of project development includes the enlargement of main and lateral channels to the capacity necessary to provide good agricultural drainage outlets for each farm located in the benefited area. Construction cost for channels and laterals considered are based upon recent contract cost of similar PL-566 projects in New York.

Table II shows the estimated structural cost of potential development. A 20 percent contingency allowance was added to the estimated construction cost. Engineering services are estimated at 9 percent of the construction cost. Administration of contracts was estimated to be 2 percent and project administration to be 18 percent of the construction cost. Land rights were estimated by observation in the field and by information shown on maps on file in the Soil Conservation Service State Office.

TABLE I - CHANNEL DATA

## Black Creek Watershed, Erie-Niagara Basin

Channel Description :	Length of Reach (miles) :	Watershed Area (sq. mi.) :	Needed Channel Capacity (cfs) :	Bottom Width (ft.) :	Depth (ft.) :	Velocity in Channel (ft./sec.) :	Estimated Volume of Excavation (cu. yds.) :
Black Creek	5	11.8	292	40	5.4	1.2	106,500
Laterals 1/	11	-	-	-	-	-	71,000

1/ Lateral channels will vary in size, length and drainage area. They are selected by map studies to provide drainage outlets to the boundary of every farm unit in the benefited area.

2/ "C" drainage design.

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TABLE II - ESTIMATED STRUCTURAL COST-POTENTIAL DEVELOPMENT

## Black Creek Watershed, Erie-Niagara Basin

Item	: : Unit	: Amount : Planned	: Estimated : Total Cost
			(Dollars) <u>1/</u>
STRUCTURAL MEASURES			
Construction			
Black Creek Channel	Miles	5.0	141,300
Laterals	Miles	11.0	64,000
Subtotal Construction			205,300
Engineering Services			18,500
Land Rights			20,000
Project Administration			37,000
Administration of Contracts			4,200
TOTAL STRUCTURAL MEASURES			285,000
<u>1/</u> Price Base: 1967			

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Table III shows the installation cost distribution of funds between PL-566 and non-federal sources. A summary of cost allocation and cost sharing is given in Table IV.

The annual cost, including the cost of operation and maintenance, is shown in Table V.

### EFFECTS AND ECONOMIC FEASIBILITY OF POTENTIAL DEVELOPMENT

Agricultural damage estimates were based on field schedule information obtained from landowners and farm operators. Information collected on the field schedules included the present land use, crop distribution by soil units, crop yields, probable shifts in crop distribution and expected land use after project installation.

Estimates of the project benefits on the acres of benefited area were based on the expected increase in yields on present cropland. Associated costs were deducted from the gross benefits to obtain net benefits.

Project benefits were discounted to account for incomplete participation in on-farm drainage systems. Benefits were further discounted to allow for a 5-year buildup to their full level.

With the potential project installed, the farmers would be able to increase their yields significantly. Table VI compares the benefits and cost for structural measures. The average annual increase in net return with the project is approximately \$67,250 on the 4,700 acres considered in the watershed. When comparing this benefit to the average annual cost involved, a 2.6:1 benefit-cost ratio results. The major factor is that the local landowners will fully utilize their land resources and change to more intensive land use after the project has been installed.

### ALTERNATE OR ADDITIONAL POSSIBILITIES

The only feasible solution to the problems in Black Creek is the channel and lateral improvements described in this report. The only other available alternatives are:

1. Ditching, diking, and pumping by individual landowners, or
2. Maintaining the same low intensity of land use.

TABLE III - DISTRIBUTION OF STRUCTURAL COST-POTENTIAL DEVELOPMENT

Black Creek Watershed, Erie-Niagara Basin  
1/  
(Dollars)

Structural Measures	Installation Cost					
	:Engineering:		:Project :		:Administration:Installation	
	:Construction:	Services	:Administration:	Rights	: of Contracts :	Cost
Black Creek Channel	141,300	12,700	25,400	10,000	2,900	192,300
Laterals	64,000	5,800	11,600	10,000	1,300	92,700
TOTAL	205,300	18,500	37,000	20,000	4,200	285,000
1/ Price Base: 1967						

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TABLE IV - COST ALLOCATION AND COST SHARING SUMMARY

Black Creek Watershed, Erie-Niagara Basin  
1/  
(Dollars)

Item	Cost Allocation		Cost Sharing	
	Purpose		PL-566	
	:		:	
	:Flood		:Flood	
	Prevention:	Drainage:	Prevention:	Drainage:
	Total	Total	Total	Total
Channel Improvement				
Black Creek and				
Laterals	121,900	121,900	243,800	111,900
			60,575	172,475
			10,000	61,325
				71,325
GRAND TOTAL	121,900	121,900	243,800	111,900
			60,575	172,475
			10,000	61,325
				71,325
1/ Price Base: 1967				

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TABLE V - ANNUAL COST

Black Creek Watershed, Erie-Niagara Basin  
 (Dollars)<sup>1/</sup>

Evaluation Unit	:Amortization of <u>2/</u> : :Installation Cost	Operation and : Maintenance Cost:	Total
1	17,080	5,700	22,780
Project Administration	2,890	-	2,890
GRAND TOTAL	19,970	5,700	25,670

1/ Price Base: Installation 1967, O&M adjusted normalized

2/ 25 years at 4-7/8 percent interest

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TABLE VI - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Black Creek Watershed, Erie-Niagara Basin

(Dollars)<sup>1/</sup>

Evaluation Unit	:AVERAGE ANNUAL BENEFITS <sup>1/</sup> :		:Average:Benefit	
	:More Intensive Land Use	: Total	:Annual : Cost	:Cost <sup>2/</sup> :Ratio
1	67,250	67,250	22,780	2.9:1
Project Administration	-	-	2,890	-
GRAND TOTAL	67,250	67,250	25,670	2.6:1

<sup>1/</sup> Price Base: 1967<sup>2/</sup> Taken from Table V

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UPPER TONAWANDA CREEK WATERSHED EVALUATION REPORT

CNI WATERSHED 148

Western New York Type IV River Basins

Erie-Niagara Basin

Genesee and Wyoming Counties, New York

October 1970

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service   Economic Research Service   Forest Service



## UPPER TONAWANDA CREEK WATERSHED EVALUATION REPORT

Erie-Niagara Basin  
Genesee and Wyoming Counties, New York  
October 1970

### LOCATION AND DESCRIPTION OF THE PROBLEM AREA

Upper Tonawanda Creek Watershed, No. 148, drains approximately 172 square miles of Genesee and Wyoming Counties above the city of Batavia (1960 population approximately 25,000). This area, located in the northeastern part of the Basin, has a subdued topography of gently rolling hills. Elevations range from a high of 2,100 msl near North Java in the southern part of the watershed to a low of 876 msl at the mouth of the watershed just west of Batavia.

Soils in the watershed generally are outwash and alluvial materials on the flood plains and the glacial tills on the uplands. Agricultural potential of the Palmyra soils on the flood plain is good. On the higher lime glacial till soils, such as Darien-Remsen Associations in the northern part of the watershed, agricultural potential is good. The lower lime Erie-Langford tills have only fair potential.

Land use in the watershed is about 35 percent cropland, 30 percent pasture and idle land, 30 percent forest and 5 percent urban and other. The only real trend which can be expected in relation to land use is an increase in the amount of urban land as Batavia expands. Agriculture will remain fairly stable in the area over the years.

### WATERSHED PROBLEMS AND NEEDS

Two distinct problem areas are present in the watershed. First is the urban damages in Batavia. Secondly, annual flooding occurs upstream of Batavia on 3,000 acres of agricultural land. This flat land floods often due to limited channel capacity and damage results primarily from the restricted use of the land resources. Some of the land in this area in permanent marsh has probably never been in agricultural production. Other areas are used infrequently as dry season pasture. This area presently provides a significant reduction in peak flows in Batavia because of the amount of flood plain storage available.

If adequate protection can be provided to this flood plain area, a shortage of irrigation water could develop in the future. There are approximately 12 miles of streambank erosion upstream from Johnsburg to Attica. In the entire watershed, there is a need for land treatment to permit more intense use of the land. Low yields on cropland and pasture and poor yield of forest crops are the specific problems relating to land treatment.

No other significant problems exist in the watershed.

## PHYSICAL POTENTIAL FOR MEETING NEEDS

The only apparent solution to the flood problem on the flood plain above Batavia would be 4.6 miles of channel widening improvement. This will also provide an adequate outlet for drainage. A channel with a bottom width of 180 feet, a top width of 220 feet, and a depth of 10 feet would be required to pass the 5-year peak flow of 7,200 cfs through the area above Batavia. The installation cost for 4.6 miles of channel improvement would be in excess of \$3,000,000 which includes stabilization of tributaries, installation sources, and maintenance.

Four potential structure sites were located in the watershed. Only one was above the problem area and it did not control enough drainage area to significantly reduce the peak flows.

The soils and topography are such that the proper land treatment measures will give protection from erosion and sediment damage.

## PROJECT FEASIBILITY AND BENEFITS

This project is not justified under existing criteria for any purpose. The damage reduction based on present agricultural use would amount to three to five dollars per acre. This would give maximum benefit of \$15,000 annually. The largest possible source of benefits from this area would result from a more intensive use with corn in a short rotation. After reduction for percentage of total acreage involved and increased cost to realize full profits, the maximum benefit is liberally estimated at \$40 per acre per year for a total of \$120,000 annually.

However, this channel improvement would seriously reduce the modifying effect of the valley storage on peak flows in Batavia. Thus, the 5-year peak discharge in Batavia would be increased from the present 5,300 cfs to 7,200 cfs or a 36 percent increase. This will reduce the amount of protection the Corps of Engineers can give to Batavia, and, therefore, must be considered as an induced damage which required mitigation. Estimated cost of mitigation is \$1,115,000 to provide higher dikes and enlarged channels in the Corps of Engineers' project through Batavia.

Converting the \$3,000,000 cost of channel improvement plus the \$1,115,000 estimated cost of improvement for mitigation in Batavia to an annual basis, gives \$139,400 as an annual cost for construction. Maintenance costs estimated at 2 percent of construction cost amounts to \$82,300 annually for a total cost of \$221,700.

The \$120,000 annual benefit versus the \$221,700 annual cost yields an unfavorable benefit-cost ratio of 0.5 to 1.0.

## LOCAL INTEREST IN PROJECT DEVELOPMENT

Local interest in the flooding problem has been expressed for many years. The U. S. Corps of Engineers has been involved in a study of the urban aspects of the problem and has prepared an interim report. Very little interest has been expressed in the upstream part of the problem. The Erie-

Niagara Regional Water Resources Planning Board is presently developing a plan for the development of the Basin. Upper Tonawanda Creek will be considered in this plan.

The proposed Sierks dam, with a controlled drainage area of 65 square miles would reduce the frequency of out-of-bank flows on the flood plain area above Batavia from a 99 percent chance of occurrence to an 89 percent chance. This reduction is not considered sufficient to cause any significant changes in the land use pattern for this area.



UPPER MURDER CREEK SUBWATERSHED EVALUATION REPORT  
PART OF CNI WATERSHED 240

Western New York Type IV River Basins  
Erie-Niagara Basin

Genesee and Wyoming Counties, New York

October 1970

UNITED STATES DEPARTMENT OF AGRICULTURE  
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## UPPER MURDER CREEK SUBWATERSHED EVALUATION REPORT

Erie-Niagara Basin

Genesee and Wyoming Counties, New York

October 1970

### LOCATION AND DESCRIPTION OF PROBLEM AREA

Murder Creek, Watershed 240, is located in the northern part of the Erie-Niagara Basin, approximately 20 miles northeast of the city of Buffalo, New York (1960 watershed population approximately 4,000). The project area is the 44 square miles above Main Street in the village of Pembroke.

Topography is relatively flat with a few gently rolling hills. Elevations range from a high point of 1,440 msl at the extreme southern part of the watershed to 815 msl at Main Street in Pembroke.

Soils in the northern part of the watershed (north of Corfu) are lake-laid sediments of the Collamer-Galen-Canandaigua-Lamson Association which has good agricultural potential with drainage.

Soils developed from glacial till dominate the middle of the watershed. These soils are the Mohawk-Manheim with good agricultural potential and the Remsen-Darien Association with fair potential for agriculture. In the south are both outwash soils of the Palmyra Association and the till soils of the Fremont-Hornell-Manlius Association. Agricultural potential is good and fair respectively. Land use in this watershed is approximately 30 percent cropland, 35 percent woodland, 30 percent pasture and idle land, and 5 percent urban. Agriculture potential is fair to good with proper management techniques. However, land use and growth trends are away from agriculture because of the problems involved in managing the land.

### WATERSHED PROBLEMS AND NEEDS

Approximately 1,050 acres of flood plain in the vicinity of Corfu is the main problem area. Poor drainage exists and frequent overbank flooding occurs because the stream gradient and channel capacity are not adequate to handle excess flows. Damage results primarily from the restricted use of the land resources. This includes late planting in the spring, restricted choice of crops which can be grown, and less than optimum use of the land.

In the entire watershed as well as on the problem area, there is a need to change the intensity of land use and management which will result in a more efficient operation. Low yields on cropland and pasture and poor yield of forest crops are the specific problems in the watershed.

A shortage of irrigation water will be a problem in the future if adequate drainage and flood control are achieved.

No other significant problems were found in the watershed.

## PHYSICAL POTENTIAL FOR MEETING NEEDS

Channel improvement appears to be the most feasible alternative to solving the problem. Approximately 10.5 miles of channel improvement are required from Elmwood Road to Pembroke. This would provide adequate drainage as well as 10-year flood protection for the 1,050 acres of flood plain land. Total installation cost for this project is \$705,300. This is based on clearing costs of \$400 per acre, common excavation \$.80 per cubic yard, and riprap at \$25 per cubic yard. Since this part of the watershed is situated above elevation 800, this project would be unaffected by the proposed U. S. Corps of Engineers' downstream development.

Five structure sites were identified in the study. Of these, three were eliminated because of high land rights costs (flooding of a railroad) or poor geology (limestone). Of those two sites remaining, only 240-1 has flood control potential as well as storage for other beneficial uses. Site 240-3 has single purpose recreational or fish and wildlife development potential only. These sites are discussed in more detail in the "Preliminary Upstream Reservoir Studies" report of the Erie-Niagara. Since site 240-1 does not control enough drainage area to significantly reduce the flooding and does nothing to improve the drainage, channels were selected as the most feasible alternative.

The soils and the topography are such that the proper land treatment measures will give protection from erosion and sediment damage.

## PROJECT FEASIBILITY AND BENEFITS

This project is not justified under existing criteria for any purpose. Net benefits were estimated to be \$13 per acre or \$13,650 annually. The average annual cost including operation and maintenance is \$55,700, giving a benefit-cost ratio of 0.25 to 1.0.

Irrigation was examined and the cost was higher than could be economically justified especially since sites were not involved in the project. It should also be pointed out that without the flood control-drainage project, irrigation is not feasible.

## LOCAL INTEREST IN PROJECT DEVELOPMENT

No interest has been shown by local leaders in the development of a PL-566 type program. The Erie-Niagara Regional Water Resources Planning Board is presently developing a plan for the Basin.

## REMARKS

Murder Creek channel improvement is obviously not a feasible project based upon agricultural benefits from improved drainage and flood protection.

The 1,050 acres benefited all lie in a relatively narrow flood plain along Murder Creek. The remainder of the watershed lies outside and at elevation high enough to not be adversely affected by high water along Murder Creek. Landowners at these higher elevations can solve the existing drain-

age problems by on-farm drainage systems and small group type drainage projects which could utilize the existing low flood plain of Murder Creek as an outlet.



# ADDITIONAL INVESTIGATIONS

## INTRODUCTION

In addition to the watershed investigation and evaluation reports, studies were made on Slate Botton, Ellicott, and Eighteenmile Creeks to determine agricultural land damages and how these damages might be solved under United States Department of Agriculture programs.

Damages were not found to be great enough to justify upstream structural measures under USDA programs. However, information on the extent and frequency of flooding is available from this study. The 100-year frequency flood area is shown on Figures B.1, B.2, and B.3 for the three streams. More detailed information, with additional maps, is available at the Soil Conservation Service State Office in Syracuse, New York.

## PROCEDURE

Hydrologic and hydraulic studies were made to determine the extent flooding occurs within each watershed. Stream cross-sections were surveyed to USGS datum to define the channels and associated flood plain areas.

Stage-discharge data was determined for each section using a computer program. The hydraulics are based on the assumption of steady flow, where the discharge through each section remains constant for the time interval under consideration.

Frequency discharge data was prepared based on USGS gage records on streams in the area. Water surface profiles were plotted on profile maps for frequencies ranging from the 2-year to the 100-year event. For the 100-year flood condition, the 100-year elevation was located at each cross-section on aerial strip maps. Using USGS topographic quadrangles and stereoscopy on aerial photographs, the 100-year flood line was drawn on the strip map between known elevations on the cross-sections.



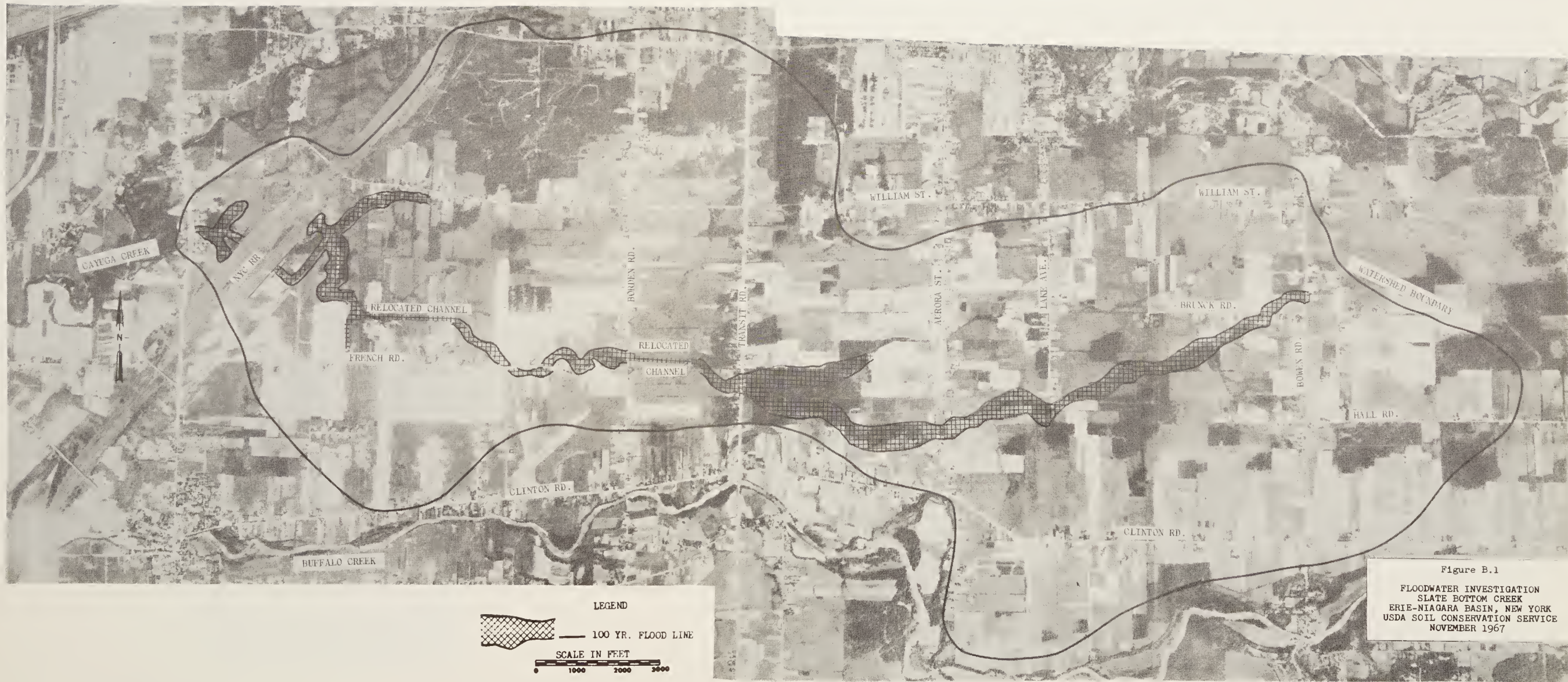
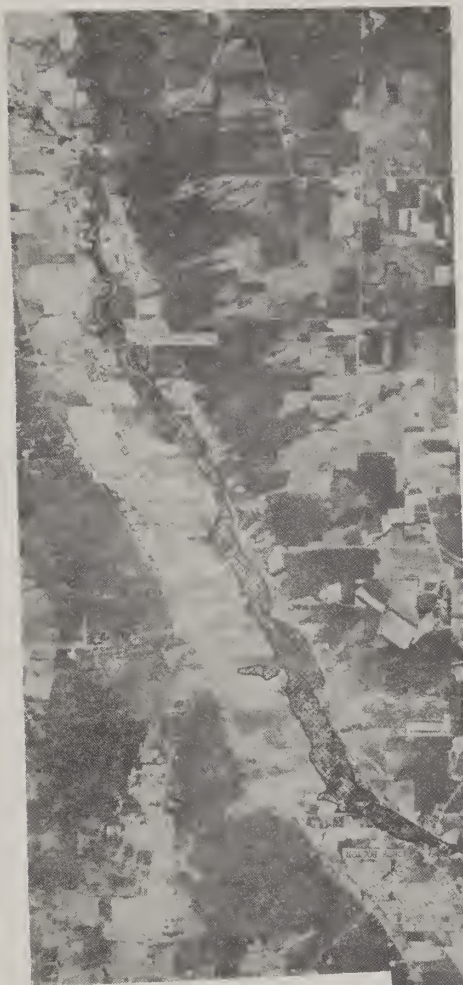






Figure B.2  
FLOODWATER INVESTIGATION  
ELLICOTT CREEK  
ERIE-NIAGARA BASIN, NEW YORK  
USDA SOIL CONSERVATION SERVICE  
NOVEMBER 1967





12/7/66

100 FT. FLOOD LINE



SCALE IN FEET

FLOODWATER INVESTIGATION  
EIGHTEENMILE CREEK  
ERIE-NIAGARA BASIN, NEW YORK  
USDA SOIL CONSERVATION SERVICE  
NOVEMBER 1967

Figure B.3



# IRRIGATION

## APPENDIX C

UNITED STATES DEPARTMENT OF AGRICULTURE REPORT  
WESTERN NEW YORK RIVER BASINS  
ERIE-NIAGARA BASIN

Prepared By

UNITED STATES DEPARTMENT OF AGRICULTURE  
Economic Research Service   Forest Service   Soil Conservation Service



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# INTRODUCTION

The study of irrigation needs was made to see what the demand for water might be and the possible sources of irrigation water. This information was needed to develop a complete water and related land resources plan for the Basin. At present, there are approximately 4,700 acres being irrigated in the Basin. Over 136,000 acres in the Basin would respond and are potentially suitable for irrigation.

The water requirement per acre of irrigation ranges from 7 to 24 inches per year with nine inches being about the average. To supply nine inches to the land, it is necessary to store approximately one acre-foot for each acre to be irrigated. The additional water is needed to offset evaporation, seepage, and transportation losses.

Delineations of irrigable lands were made on 7 1/2 minute topographic quadrangles. The acreage was tabulated by watershed, county, and irrigable land groups to facilitate interpretations and needed land treatment measures. Each reservoir site listed in the *Preliminary Upstream Reservoir Studies* (Appendix A) was screened to determine if the site would be feasible to construct as a single-purpose irrigation project.

All lands that could be irrigated from natural sources of water, primarily streams, were delineated. This was limited to those lands which would have a distribution cost of less than \$30 per acre.

To meet some of the irrigation needs, seven projects are recommended for early action. They include 19 reservoirs to supply irrigation water to 6,400 acres. The total cost of these structural measures is \$7.5 million.

Weighted per acre irrigation water requirements were developed by the modified Blaney-Criddle method. Mean monthly temperatures and mean monthly and annual precipitation figures used in the formula were averages of eight stations scattered randomly over the entire Basin (Tables C.1 and C.2). The average carryover of soil moisture was estimated to be 2.4 inches (75 percent of 3.2 inches field capacity).

Table C.1. Mean Monthly Temperatures for Selected Stations in the Erie-Niagara Basin

Stations	Mean Monthly Temperatures				
	May Degrees	June Degrees	July Degrees	August Degrees	September Degrees
Arcade	54.2	62.7	67.4	65.1	58.8
Batavia	55.7	66.0	70.4	68.4	60.7
Buffalo	55.4	65.5	70.6	68.9	62.4
Derby	53.7	65.3	70.4	69.2	62.8
Elma	54.4	64.7	69.1	67.8	60.7
Gowanda	56.2	66.9	71.1	69.3	62.8
Lockport	57.0	66.3	71.4	69.6	62.4
S. Wales	55.0	64.9	69.6	67.5	60.4
Average	55.2	65.3	70.0	68.2	61.4

Source: U. S. Weather Bureau, Climatic Summary of the United States

Table C.2. Mean Monthly and Annual Precipitation for Selected Stations in the Erie-Niagara Basin

Stations	Mean Monthly Precipitation					Mean Annual
	May Inches	June Inches	July Inches	August Inches	September Inches	Precipitation Inches
Arcade	3.52	3.65	3.33	3.54	3.48	39.44
Batavia	3.08	2.66	2.90	3.11	2.65	31.55
Buffalo	2.91	2.49	2.68	3.28	2.99	34.26
Derby	3.67	2.95	2.51	3.11	3.77	38.84
Elma	3.52	2.84	3.09	3.02	3.78	40.01
Gowanda	3.26	3.39	3.34	3.31	3.15	36.53
Lockport	3.11	2.38	2.77	3.13	2.75	31.94
S. Wales	3.42	3.20	3.23	3.12	3.45	40.08
Average	3.31	2.94	2.98	3.20	3.25	36.58

Source: "Precipitation in New York State", Bernard E. Dethier Bulletin 1009, New York State College of Agriculture, Ithaca, New York

Since crop growth stage coefficient curves were not available for all crops in the composite acre, estimates were made only for tomatoes, potatoes, and small vegetables. Consumptive use and irrigation water requirements for these crops are contained in Table B.3. The average net irrigation requirement is the average monthly consumptive use less average monthly effective rainfall and average carryover of soil moisture.

Average gross irrigation requirement is the average net irrigation requirement adjusted by the estimated 75 percent field application efficiency for sprinkler irrigation in Western New York. The 20 percent chance of net irrigation requirement is the average monthly consumptive use less the 80 percent chance of monthly effective rainfall and the 80 percent chance of average carryover of soil moisture.

A 20 percent chance represents an irrigation requirement that can be expected to be equalled or exceeded two years out of ten. Twenty percent chance of gross irrigation requirement is 20 percent chance of net irrigation requirement adjusted for the estimated field application efficiency.

Table C.3. Consumptive Use and On-Farm Irrigation Water Requirements for Selected Crops in the Erie-Niagara Basin

Crop and Month	: Ave. Monthly Consumptive Use	: Ave. Net Irrigation Requirement	: Ave. Gross Irrigation Requirement	: 20% Chance Net Irrigation Requirement	: 20% Chance Gross Irrigation Requirement
<u>Tomatoes</u>					
May	.6	None	None	None	None
June	2.6	None	None	None	None
July	5.1	None	None	1.9	2.6
August	5.8	1.8	2.4	3.8	5.1
September	3.2	1.2	1.6	1.5	2.0
TOTAL	17.3		4.0		9.7
<u>Potatoes</u>					
May	.4	None	None	None	None
June	2.6	None	None	None	None
July	6.5	2.6	3.4	3.3	4.4
August	7.6	4.9	6.6	5.4	7.2
September	5.2	2.9	3.8	3.2	4.3
TOTAL	22.3		13.8		15.9
<u>Small Vegetables</u>					
June	2.3	None	None	None	None
July	4.9	.8	1.1	1.4	1.8
August	4.7	2.4	3.2	2.7	3.6
September	2.4	.5	.7	.7	1.0
TOTAL	14.3		5.0		6.4

Crop Weights: Tomatoes = 11%

Potatoes = 12%

Small Vegetables = 77%

Weighted Average Irrigation Water Requirement =  $(9.7 \times .11) + 15.9 \times .2 + (6.4 \times .77) = 7.9$  inches

Benefits expected from supplemental irrigation were developed on a composite acre basis. The composite acre consists of a proportional mix of crops suited to irrigation and presently grown in the Basin. The proportions are based on the acreage of each crop grown in counties in the Basin according to the 1964 Census of Agriculture with some minor crops omitted due to lack of information concerning production costs or response to irrigation. The proportions are as follows:

<u>Crop</u>	<u>% of Composite Acre</u>
Snap Beans	46.9
Sweet Corn	14.0
Potatoes	13.2
Tomatoes	11.6
Cabbage	5.9
Broccoli	2.6
Strawberries	2.5
Beets	1.9
Cauliflower	1.4

Unirrigated yield information and production costs were developed from cost and return studies conducted by the Department of Agricultural Economics, New York State College of Agriculture, Cornell University, Ithaca, New York. (Table C.4) The prices used are taken from *Interim Price Standards for Planning and Evaluating Water and Land Resources*, Water Resources Council, April 1966 and adjusted for New York by applying a New York State/United States price ratio.

An estimation of yield response to irrigation was made for each crop from information contained in Bulletin 800, New York State Agricultural Experiment Station, Geneva, New York, August 1963, *Crop Response to Irrigation in the Northeast*, and from more recent unpublished data on irrigation response from Geneva experiments. Yield response for broccoli, strawberries, and cauliflower were estimated from other sources. Irrigation cost per acre was developed from the basic survey data summarized in A.E. 1061, Department of Agricultural Economics, Cornell University, *Operating Costs for Irrigation Equipment, Western New York, 1956*.

Weighted net returns per acre are developed in Tables C.4 through C.8. Net returns for the unirrigated acre were \$41 and for the irrigated acre \$69, providing net per acre benefits from irrigation of \$28.

Table C.4. Yields and Costs Per Acre Without Irrigation for Selected Crops - Erie-Niagara Basin

Crop	Yield	Costs Per Acre		Total
		Growing	Harvesting	
		\$	\$	\$
Snap Beans	1.6 tons	92	40	132
Sweet Corn	3.0 tons	51	26	77
Potatoes	262 cwt	221	86	307
Tomatoes	14.5 tons	270	199	469
Cabbage	24.5 tons	163	52	215
Broccoli	32 cwt	127	76	203
Strawberries	34 cwt	391	339	730
Beets	11.6 tons	134	54	188
Cauliflower	6.0 tons	318	265	583

Table C.5. Yields and Costs Per Acre With Irrigation for Selected Crops - Erie-Niagara Basin

Crop	Response to Irrigation: %	Yield	Cost		Total Cost With Irrigation
			Irrigated	Irrigation With	
			\$	\$	\$
Snap Beans	33	2.1 tons	25	53	170
Sweet Corn	30	3.9 tons	25	33	109
Potatoes	30	340 cwt	25	112	358
Tomatoes	30	19.3 tons	25	265	560
Cabbage	25	30.5 tons	25	65	253
Broccoli	37.5	44 cwt	25	104	256
Strawberries	24	42.5 tons	25	423	839
Beets	60	18.6 tons	25	86	245
Cauliflower	30	7.8 tons	25	344	687

Table C.6. Prices Per Hundredweight and Returns Per Acre Without Irrigation for Selected Crops - Erie-Niagara Basin

Crop	: Price Per : Cwt	: Gross Return : Per Acre	: Total Cost : Per Acre	: Net Return : Per Acre
	\$	\$	\$	\$
Snap Beans	4.75	152	132	20
Sweet Corn	1.13	68	77	-9
Potatoes	1.65	432	307	125
Tomatoes	1.60	464	469	-5
Cabbage	.70	342	215	127
Broccoli	7.41	237	203	34
Strawberries	27.68	941	730	211
Beets	.96	223	188	35
Cauliflower	7.41	857	583	274

Table C.7. Weighted Net Returns for a Composite Acre of Selected Crops Without Irrigation - Erie-Niagara Basin

Crop	: : Percent of Total	: : Net Returns	: : Weighted Net : Returns Per Acre
		\$	\$
Snap Beans	47	20	9
Sweet Corn	14	-9	-1
Potatoes	13	125	16
Tomatoes	12	-5	-
Cabbage	6	127	8
Broccoli	2	34	1
Strawberries	2	211	4
Beets	2	35	1
Cauliflower	1	274	3
TOTAL	100		41

Table C.8. Returns Per Acre with Irrigation for Selected Crops - Erie-Niagara Basin

Crop	:Gross Return: :Per Acre	:Total Cost: :Per Acre	:Net Return: :Per Acre	:Weighted Net :Return Per Acre
	\$	\$	\$	\$
Snap Beans	200	170	30	14
Sweet Corn	88	109	-21	-3
Potatoes	561	358	203	26
Tomatoes	618	560	58	7
Cabbage	427	253	174	10
Broccoli	326	256	70	2
Strawberries	1,176	839	337	7
Beets	357	245	112	2
Cauliflower	1,114	687	427	4
TOTAL				69

The studies of the potential for development of irrigation can be broken into several sections. First, lands suited for irrigation and those presently irrigated were identified. Next, the water requirements per acre irrigated were determined. Potential sources of irrigation water were located and related to nearby areas of irrigable land.

## IRRIGABLE LANDS

### ASSUMPTIONS

Not all soils in the Basin are capable of being irrigated economically. To determine irrigation feasibility it is necessary to consider (correlate) some assumptions of crop, economic, engineering and soil factors. These include:

1. The method of irrigation is an adequately designed sprinkler system.
2. Topography is restricted to 0-5 percent slopes.
3. Crops to be irrigated are vegetables, berries, and fruit adapted to local climatic and site conditions. These include crop groups 1,2,3,4, and 6 in the Soil Conservation Service, Conservation Irrigation Guide for New York. Also included as irrigable crops are grasses on golf courses and turf farms.
4. Landowners are using the best cultural, and conservation and water management practices feasible for their operation.
5. The practical maximum limit to irrigate most soils is 24 inches.
6. Soils considered irrigable are well drained or capable of being adequately drained for intensive use and are capable of accepting (infiltration) and transmitting (permeability) irrigation water at least 0.2" per hour.

### DEFINITIONS

#### DRAINAGE GROUPS

1. None - These soils are well or excessively drained. No drainage practices are needed except on small inclusions of wetter soils which may occur in the landscape.

2. Moderate - Soils in this group are moderately well drained. Drainage needs are moderate. More intensive drainage systems may be installed on nearly level (0-3 percent slopes) to facilitate more intensive cropping systems and/or early equipment operations.
3. Intense - These soils are somewhat poorly drained or wetter. Intensive drainage systems need to be installed. It is presumed that a suitable outlet is available or feasible to construct.

#### PERMEABILITY CLASSES (24 INCH DEPTH)<sup>1/</sup>

1. Rapid - Includes permeability classes moderately rapid, rapid and very rapid (2.5" - 6.3" +/hr.). 2/
2. Moderate - Includes permeability classes moderately slow and moderate (0.2" - 2.5"/hr.).

#### IRRIGABLE LAND GROUPS

##### Group 1 - Rapid Permeability - No Drainage Needed

Soils in these areas are dominantly well to excessively drained outwash sands and gravels, and lacustrine sands. They occur as stream terraces, old lake beaches and gently rolling landforms. Their capacity to hold water is moderate to low. Only minor inclusions need drainage within this delineation.

##### Group 2 - Moderate Permeability - No Drainage Needed

These soils are well drained and developed from alluvial sediments, glacial till and medium-textured lacustrine sediments. Flood plains, high bottom terraces and gently rolling lake plain and upland landforms are where these soils are found. The moisture-holding capacity is high to moderate. Inclusions within this delineation may need drainage. Flooding is a hazard on alluvial soils of the flood plain.

##### Group 3 - Rapid Permeability - Moderate Drainage Needed

This group of soils is moderately well drained, and developed from lacustrine sands. Nearly level to gently rolling landforms on the lake plain are typical. Some areas are underlain by less permeable material usually below 24 inches. Most of these areas are not extensive and include soils of a less permeable nature. Their ability to hold moisture is low to moderate.

<sup>1/</sup> These permeability classes are defined in the USDA Soil Survey Manual.  
<sup>2/</sup> Modified for use in New York.

Group 4 - Moderate Permeability - Moderate Drainage Needed

These are moderately well drained soils developed in outwash deposits, medium-textured lacustrine material, medium glacial till and alluvial sediments. They occur on flood plains, outwash terraces and on nearly level to gently sloping lake plain and upland topography. Moisture holding ability is high to moderate. Flooding is a hazard on alluvial soils of the flood plain.

Group 5 - Rapid Permeability - Intense Drainage Needed

Soils in these areas range from somewhat poorly to very poorly drained lacustrine sands and those of organic origin. Some areas are underlain by less permeable material at approximately 24 inches. Topography is generally nearly level except small areas of somewhat poorly drained soils may be gently sloping. The capacity of these soils to hold water is low to high. Water management practices to control the water table on some of these soils will be beneficial.

Group 6 - Moderate Permeability - Intense Drainage Needed

Somewhat poorly to very poorly drained soil developed from outwash sand and gravel, lacustrine deposits, alluvial sediments, and glacial till are typical of this area. Nearly level areas are the most common, but some areas are gently sloping. The moisture-holding capacity is high to moderate. Flooding is a hazard on alluvial soils on the flood plain.

## PROCEDURES

### DELINEATIONS

From current soil survey field sheets for each soil and water conservation district, soil mapping units (soil type - slope-erosion) were evaluated according to the standards of the defined irrigable land groups. Areas considered irrigable were transferred to 7 1/2 minute topographic quadrangles and keyed to the appropriate irrigation land group.

Delineations were made on open land except in the Cattaraugus Indian Reservation. This is the largest area of soils having no limitation for agricultural use. The potential is so good that forested areas on the reservation were also delineated on the irrigable land map. Clearing this land for agricultural use is considered economical.

Irrigable land areas were measured and tabulations in Table C.9 show 136,000 acres of potential irrigable land and Figure C.1 shows its distribution within the Basin.

## STORAGE REQUIREMENTS PER ACRE IRRIGATED

Based upon antecedent soil moisture, probable rainfall and consumptive use by crops, a water budget was developed. This budget encompassed the water needed by the plant plus losses due to efficiency of application, transportation and storage. Ultimately, it was determined that about one acre-foot of water should be stored for each acre of land to be irrigated.

## IMPOUNDMENT SITES

A feasibility study was made for all possible irrigation impoundments resulting in a final list of 19 feasible irrigation sites. The irrigation storage was fixed by a generalized relationship of the ultimate storage potential and the total demand of the area within reasonable distance of the site. Factors affecting the total selected irrigation storage were: (1) topographic features and limits, (2) irrigation demand (normally up to 5 miles downstream from the site), and (3) water yield from the drainage area.

## IRRIGATION DISTRIBUTION

The irrigation distribution considered involves the transfer of irrigation water from a point of supply to a point of distribution. The purpose of this distribution is to irrigate large areas which are such a distance away from the water supply that they cannot be irrigated with normal type irrigation equipment. It is assumed that all large irrigable areas over 1/2 mile from a point of supply will require this distribution system.

The method of delivery is to pump the amount of water required through an underground pipeline to the point of distribution. A pumping station would be located at the water source with a stream block providing a sump pool for the pump. The underground pipeline would deliver the water to the distribution point. Landowners would connect directly onto the main pipeline with their lateral pipelines and booster pumps or they might pump from a small storage pond which would be constructed at the end of the main underground pipeline.

Total pumping requirements are based on peak capacity of 10 gallons per minute per acre irrigated.

Table C.9. Estimated Potential Irrigable Land -  
Erie-Niagara Basin, New York

Water- sheds	: Allegany	: Cattaraugus	: Chautauqua	: Erie	: Genesee	: Niagara	: Orleans	: Wyoming	: Total
1				12,000	200			7,000	19,200
44	15,800	2,000		16,000				3,000	36,800
56				3,000					3,000
57				5,000	1,500			200	6,700
72				6,000					6,000
115				500					500
148					9,000			5,000	14,000
203				300					300
238				500	12,000	700			13,200
239				8,500		4,000			12,500
240				3,000	10,000				13,000
241				8,000					8,000
244				-					
245					500	2,300			2,800
TOTAL	15,800	2,000		62,800	33,200	7,000		15,200	136,000

Eighty-five irrigators in the Basin are known to Extension Service agents and Soil Conservation Service district conservationists. Irrigators are applying water on market and process vegetables, potatoes, nursery stock, and golf courses. During the winter, two landowners are applying water through snow-making machines to make new snow for better skiing, and to lengthen the skiing season. Table C.10 estimates the land presently irrigated and the farm numbers correspond to the locations shown on Figure C-1.

Vegetable growers find it necessary to use sprinkler irrigation during summer drought periods and in the early spring. Spring irrigation is used to guarantee adequate soil moisture to keep transplants from wilting, to firmly pack the seedbed around small vegetable seeds for more uniform germination, and to control frost. Many farmers now irrigating in the Brant-Eden Valley area are irrigating soils which in this study are not considered irrigable. Several factors influence this:

1. They have an irrigation system and are using it on as much of their operating unit as they can.
2. Very favorable local climatic conditions allow growers to raise market and process vegetables on less permeable soils.
3. On many of these areas, growers plant later crops or earlier maturing varieties. Plantings are often in late May or June.
4. After a field is planted with transplants, irrigation water is applied to be certain that sufficient moisture is available to reduce wilting. This is a common practice on both permeable and more restricted soils.

Table C.10. Estimate and Location of Land Presently Irrigated,  
Erie-Niagara Drainage Basin, New York

Farm: Watershed:			: Est. :	:	:
No. : No. : Township			: Acres :	:	:
			: Irrig. :	Source of Water	Type of Crops
1	56	Eden	200	Wells-Pond	Market
2	56	Hamburg	30	Well	Market
3	56	Eden	100	Well-Creek	Market
4	56	Eden	30	Creek	Market
5	56	Eden	90	Pond-Creek	Market
6	56	Eden	50	Well-Creek	Market
7	56	Eden	30	-	Market
8	56	Eden	90	Well-Pond-Creek	Market
9	56	Eden	25	Pond	Market
10	56	Eden	50	Pond	Market
11	203	Hamburg	25	-	Market
12	203	Hamburg	30	-	Market
13	203	Hamburg	15	Well	Market
14	72	Brant	90	Well-Creek	Market-Process
15	72	Eden	5	-	Market
16	72	Eden	20	Pond	Market
17	72	Eden-Sardinia	100	Pond	Market
18	72	Brant	50	Well	Nursery
19	72	Brant	50	Well	Nursery
20	72	Brant	70	Well	Nursery
21	72-44	Brant	100	Pond	Market-Process
22	72	Brant	50	Pond-Creek	Process
23	72	North Collins	100	Well-Pond-Creek	Process
24	72	North Collins	25	-	Market-Process
25	72	Brant	30	Pond-Creek	Market-Process
26	72	Brant	100	Pond	Process
27	72	Brant	35	Pond-Creek	Process
28	44	Collins	50	Pond	Market-Process
29	72	Brant	40	-	Market-Process
30	72	Brant	40	Creek	Market-Process
31	72	Brant	25	Pond	Market-Process
32	1	Orchard Park	200	Pond	Process
33	1	Alden-Elma	50	Pond-Creek	Market
34	1	Sardinia	40	Pond	Potatoes
35	1	Alden	30	Pond-Creek	Potatoes
36	115	Orchard Park	20	Pond	-
37	115	Orchard Park	50	-	Market
38	44-72	N. Collins-Cattar.	100	Pond-Cistern-Creek	Market
39	57	Amherst	75	-	Market
40	44	Collins	70	Pond	Process
41	44-56	Boston-Collins	30	Pond-Creek	Potatoes
42	72	North Collins	10	Pond	Market
43	56	Concord	75	Pond-Spring-Sump	Potatoes
44	203	Hamburg	50	-	Potatoes
45	1	Elma	15	Pond	Market

(Continued)

Farm: Watershed:			: Est. :	:	:
No. :	No. :	Township	: Acres :	: Source of Water :	: Type of Crops :
46	1	Elma	10	Co. Water System	Nursery
47	72	Eden	20	Pond	Process
48	56	Hamburg	10	Pond	-
49	72	Brant	20	-	-
50	57	Amherst	20	-	-
51	72	Evans	30	-	Market
52	72	Brant	20	Pond	-
53	72	Brant	25	Pond	-
54	72	Brant	40	Pond	-
55	72	Brant	-	-	-
56	56	Eden	50	Pond	-
57	72	Brant	60	Pond	-
58	56	Eden	10	Pond	-
59	72	Eden	50	Pond	-
60	56	Eden	40	Pond	-
61	1	Cheektowaga	20	Creek	-
62	1	Cheektowaga	40	Creek	-
63	1	Aurora	75	Pond	-
64	1	Elma	90	Pond-Creek	Golf Course
65	44	Concord	75	Pond	Golf Course
66	42	Collins	90	Pond	Golf Course
67	57	Clarence	75	Pond	Golf Course
68	239	Newstead	75	Pond	Golf Course
69	57	Amherst	90	Pond	Golf Course
70	57	Amherst	40	Creek	Golf Course
71	115	Orchard Park	60	Pond-Creek	Golf Course
72	203	Hamburg	75	Pond	Golf Course
73	1	Concord	20	Creek	Snow-Golf Course
74	1	Colden	20	Creek	Snow
75	239	Clarence	20	Pond	Golf Course
76	203	Hamburg	90	Pond	Golf Course
77	1	Sheldon	60	Creek	Golf Course
78	1	Holland	20	Creek	Market
79	44	Otto	20	Creek	Process
80	57	Amherst	60	Creek	Golf Course
81	241	Amherst	75	Pond-Municipal	Golf Course
82	57	Amherst	60	Co. Water System	Golf Course
83	203	Hamburg	60	Lake Erie	Golf Course
84	1	Lancaster	60	Creek	Golf Course
85	238	Batavia	400	Creek-Pond	Process

TOTAL 4,725



WATERSHED INVESTIGATION REPORT OF IRRIGATION PROJECTS  
WESTERN NEW YORK TYPE IV RIVER BASINS  
ERIE-NIAGARA BASIN

Watershed No. 1 - Buffalo Creek  
1B - Little Buffalo-  
Cayuga Creeks

Watershed No. 44 - Cattaraugus Creek  
44A - Clear Creek  
44B - Thatcher Brook  
44C - Upper Cattaraugus Creek  
44D - Elton Creek

Watershed No. 72 - Little and Big Sister Creeks  
72A - Delaware-Muddy Creeks

Watershed No. 238 - Middle Tonawanda Creek  
238A - North Pembroke

Cattaraugus County, New York  
Erie County, New York  
Genesee County, New York  
Wyoming County, New York

December 1969

UNITED STATES DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE



# WATERSHED INVESTIGATION REPORT OF IRRIGATION PROJECTS

## ERIE-NIAGARA BASIN

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## PREFACE

Selected watersheds are investigated under River Basin Authority in sufficient detail to determine the potential that exists in these watersheds to help solve the water and related land resource problems and needs through Public Law 566 type watershed projects..

Where it is determined that a project is potentially feasible and should be initiated within 10 to 15 years, a watershed investigation report is prepared. The primary purpose in the seven project areas in the Erie-Niagara Basin is irrigation, but other purposes such as flood prevention, low flow augmentation, recreation and fish and wildlife are also included. Project areas are:

Little Buffalo-Cayuga Creeks  
Clear Creek  
Thatcher Brook  
Upper Cattaraugus Creek  
Elton Creek  
Delaware-Muddy Creeks  
North Pembroke

Irrigation, as a primary or secondary purpose, is within the scope of Public Law 566. Current policy restrictions preclude its inclusion as the primary purpose of the project. They are discussed as part of the water resource concept with the idea that future policy will allow them to be constructed.

This watershed irrigation report is prepared to enumerate the needs and problems, to propose solutions, and to evaluate costs and benefits. This information can help the Erie-Niagara Regional Water Resources Planning Board develop their water resources plan. Further, other interested local organizations will find the report useful in initiating the development of any of the project areas.

# WATERSHED INVESTIGATION REPORT OF IRRIGATION PROJECTS

Western New York Type IV River Basins  
Erie-Niagara Basin

## WATERSHEDS IN BRIEF

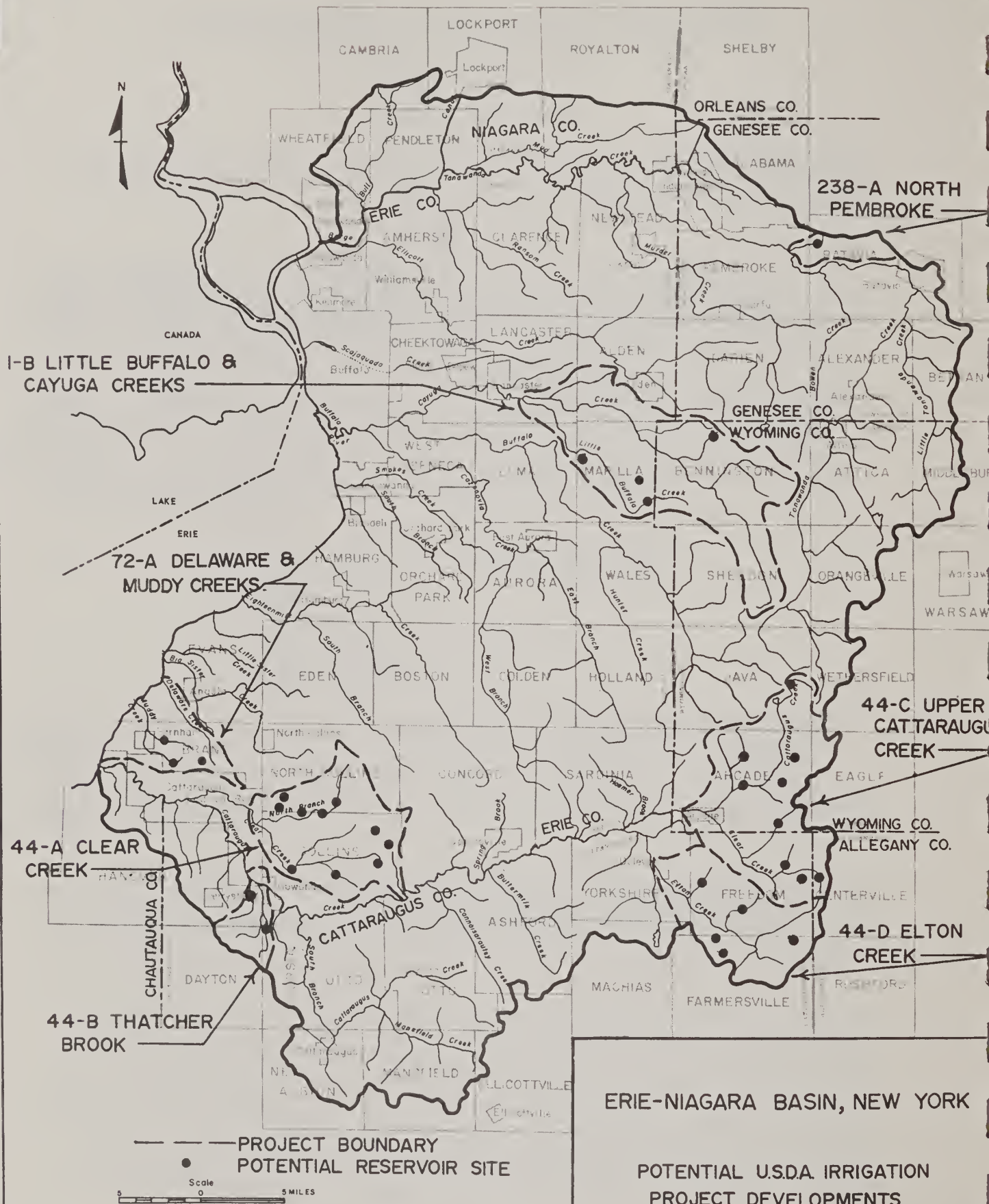
Seven potential USDA irrigation project areas have been identified in the Erie-Niagara Basin. These areas are subwatersheds of the following Conservation Needs Inventory (CNI) watersheds:

CNI Watershed	Irrigation Project Area	Project Area (Sq.Mi.)	County	Land <sup>1/</sup> Resource Area	Prin. Agriculture
1 Buffalo Creek	Little Buffalo-Cayuga Creeks (1B)	93	Erie	L-101	Dairy
44 Cattaraugus Creek	Clear Creek (44A)	55	Erie	R-140	Dairy & Process Vegetables
	Thatcher Brook (44B)	13	Cattar- <sup>2/</sup> augus	R-140	Dairy
	Upper Cattaraugus Creek (44C)	70	Wyoming Cattar- <sup>2/</sup> augus	R-140	Dairy
	Elton Creek (44D)	38	Cattar- <sup>2/</sup> augus	R-140	Dairy
72 Little and Big Sister Creeks	Delaware-Muddy Creeks (72A)	27	Erie	L-100	Market & Process Vegetables
238 Middle Tonawanda Creek	North Pembroke (238A)	7	Genesee	L-101	Dairy & Cash Crops

<sup>1/</sup> Refer to Land Resource Area Map (Figure 3.1)

<sup>2/</sup> In the Seneca Trail Resource Conservation and Development (RC&D) project area

The project areas are in three land resource areas. Gently rolling with intermittent flat landscapes characterize the terrain in L-100, the Erie-Huron Plain, and L-101, the Ontario-Mohawk Plain of the Lake States Fruit, Truck and Dairy Region. In R-140, the Glaciated Allegheny Plateau and Catskill Mountains of the Northeastern Forage and Forest Region, the landforms in the four areas within the Cattaraugus Creek watershed have broad, gently to moderately sloping hilltops and narrow, steep-sided valleys. At the fringe of the Plateau in the eastern section of the Little Buffalo-Cayuga Creeks area, however, the landforms are gently to moderately rolling.



## NEW YORK

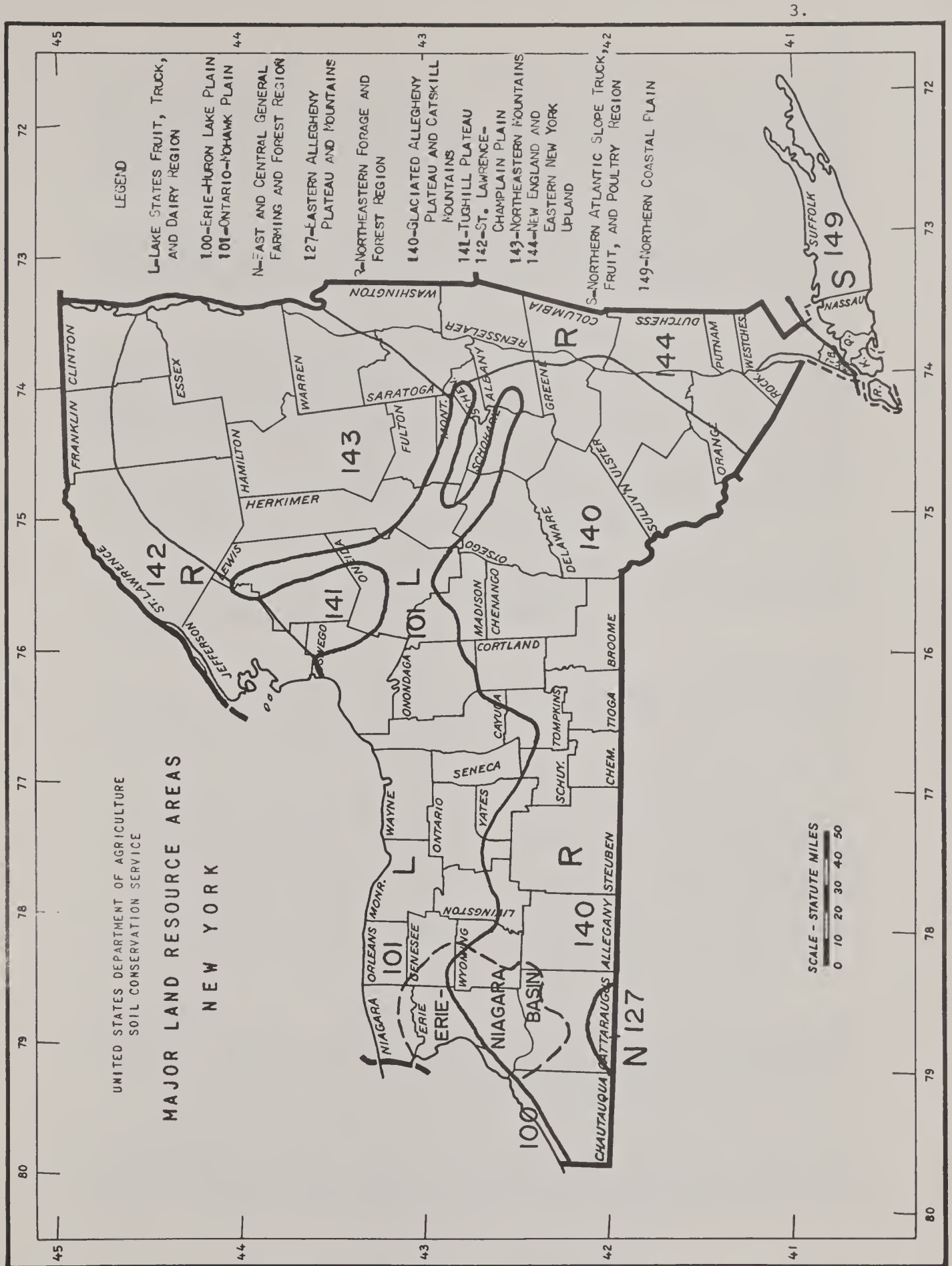


FIGURE 2

4.

Bedrock underlying the project areas is shale, siltstone, sandstone, and limestone. Shale is the dominant type of bedrock. Soils in these areas are developed from glacial till, outwash, and lake-laid sediments. Glacial till is dominant in all the project areas. For more detailed soils information, refer to the publication, *General Soils Areas of the Erie-Niagara Basin*.

Market and process vegetables dominate the agricultural land use in the Delaware-Muddy Creeks area; dairy and cash crops in North Pembroke, and dairy with small amounts of vegetables in the project areas within the Allegheny Plateau.

An estimated 1,350 acres of forest land is in public ownership, 1,500 acres are part of the Cattaraugus Indian Reservation, with approximately 53,600 acres in private ownership. The major timber types are beech-birch-maple and oak-hickory on the drier sites with ash-elm-red maple occupying most areas with a high water table. Softwood plantations have been established on many areas of former farmland.

Trout waters are found in the Little Buffalo-Cayuga, Clear, Upper Cattaraugus, and Clear Creeks project areas.

Land uses in each project area are estimated to be:

<u>Project Area</u>	<u>Cropland</u> %	<u>Grassland</u> %	<u>Forest</u> %	<u>Idle</u> %	<u>Urban</u> %
Little Buffalo- Cayuga Creeks (1-B)	25	30	30	12	3
Clear Creek (44-A)	30	35	25	8	2
Thatcher Brook (44-B)	16	30	49	4	1
Upper Cattaraugus Creek (44-C)	30	26	36	7	1
Elton Creek (44-D)	30	30	31	9	-
Delaware-Muddy Creeks (72-A)	30	20	23	24	3
North Pembroke (238-A)	35	20	38	7	-

Markets for dairy products, livestock, cash crops, fresh and processing vegetables exist in the Erie-Niagara Basin or nearby areas. Markets also exist in the same areas for sawlogs, Christmas trees, maple products, firewood, and other forest products.

In all project areas, the trend is to fewer farms with more acres per farm and slightly less total acreage in farms than at present. Meanwhile, the building of individual houses in each area will increase and some small tract developments will take place in the Erie County part of the Little

Buffalo-Cayuga Creeks, at Arcade in Upper Cattaraugus Creek, and at Gowanda in Thatcher Brook.

Climate in the project areas is humid temperate. Mean monthly temperatures and precipitation during the growing season are:

	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>
Temperature (°F.)	55.2	65.3	70.0	68.2	61.4
Precipitation (In.)	3.31	2.94	2.98	3.20	3.25

### WATERSHED PROBLEMS AND NEEDS

#### Agricultural Water Management

Currently 23 landowners in the project areas are irrigating 1,100 acres of market and process vegetables and golf courses. Irrigators indicate stream flows during the growing season are not adequate to supply sufficient irrigation water except on a limited area. Ground water supplies are inadequate in most of the project areas, however, where a good ground water supply is available, this source is undeveloped.

Agricultural water management during the growing season ranges from two extremes - excess water with the need for drainage in the spring and fall to drought periods in July and August with the need for irrigation water.

Within the project areas, approximately 27,000 acres of irrigable land have been delineated. Of this irrigable land, 2,000 acres have a drainage problem. Irrigation and drainage are especially critical on market and process vegetable enterprises.

Growers need adequate drainage to enable earlier spring planting, to prevent water-caused damage to crops during wet periods, and for easier harvesting in the fall. Vegetable growers find it necessary to use sprinkler irrigation during the summer drought periods and also in the spring. Spring irrigation is needed to guarantee adequate soil moisture to keep transplants from wilting, to firmly pack the seedbed around the small vegetable seeds for more uniform germination, and within the past few years to control frost. Drainage and irrigation are also needed to increase yields and improve the quality of vegetables and berries.

#### Floodwater

Floodwater damages to agricultural areas on the narrow flood plains of the project areas are minor, although flood damage in the village of Gowanda by Thatcher Brook is estimated to average \$4,420 annually.

#### Erosion and Sediment

Erosion in the project areas is mainly sheet erosion and is moderate in degree. Sections in the Clear Creek and Thatcher Brook areas have a high

erosion hazard because highly erodible soils are on steep topography. Erosion reduces the effectiveness of agronomic practices and the application of irrigation water. There is a need to improve the hydrologic condition of all land uses in the project areas.

Loss due to streambank erosion on most streams in these projects is small in area and damages are mostly to low value land. Streambank erosion endangers roads, bridges, and homesteads on Elton Creek and the south branch of Upper Cattaraugus Creek (also called Clear Creek in Cattaraugus County.) Streambank erosion control work was done as a part of the Buffalo Creek project where economically justifiable on the banks of Cayuga Creek to reduce sedimentation in Buffalo Harbor. Trout fisheries are damaged by sediments from sheet and streambank erosion, and by low stream flow.

Sediments from all sources lower water quality for fish, and also reduces the quality for all other uses, including aesthetics.

#### Recreation and Fish and Wildlife

Although there are numerous recreation facilities in and around the Basin, many of these facilities are overcrowded. An increasing population will necessitate the development of new facilities within easy commuting distance of the population centers. The greatest demand will be for swimming, boating, fishing, and associated water-based facilities. Both public and private development of all types of facilities are needed not only in the irrigation project areas, but also throughout the Erie-Niagara Basin.

Currently, the number of hunting and fishing licenses purchased by area residents is one of the highest in the state and is increasing each year. At the same time, wildlife and fish habitats are being slowly eliminated by urban expansion and pollution. Increased posting of private lands has further reduced the areas available for hunting and fishing. A Division of Fish and Wildlife study of the Erie-Niagara Basin determined the major needs to be the preservation and development of wildlife and fish habitat, reduction of posted land, improved public access to streams and lakes, additional water impoundments, and the reduction of pollution.

#### Nonagricultural Water Management

Water quality deteriorates as stream flows decrease or where large amounts of polluting agents are added to the streams. In specific project areas, pollution is a significant problem between Cowlesville and West Alden on Cayuga Creek, from Sandusky to below Arcade on Upper Cattaraugus Creek, and above Delevan on Elton Creek.

All the project areas are predominantly rural and the need for municipal and industrial water supplies is limited. Needs for additional water in Farnham and the section of Gowanda in Erie County can be served by the Erie County Water Authority. A need exists for additional water for municipal and industrial use at Arcade in the Upper Cattaraugus Creek project area.

## Suburban Development

Inadequate planning and unsound development of suburban areas are presently occurring in Little Buffalo-Cayuga Creeks in Erie County, Upper Cattaraugus Creek near Arcade, and Thatcher Brook at Gowanda. This will have a deteriorating effect upon environmental quality. The environmental problems are related to erosion and sediment, pollution, retention of open space, aesthetics, land values, taxation, and the dislocation of rural-based enterprises.

## PHYSICAL POTENTIAL FOR MEETING NEEDS

The potential for meeting the needs for irrigation, recreation, fish and wildlife, low flow augmentation, and municipal and industrial water is good. Full utilization of natural stream flow can alleviate some of the irrigation needs, however, additional water from impoundments and the development of ground water sources are needed. The Basin map shows the location of 34 potential reservoir sites which have been identified for all purposes. Also, the development of ground water sources may be an alternative for irrigation in Upper Cattaraugus and Elton Creeks.

A coordinated program of land use planning and the installation of land treatment measures for erosion control, drainage, and soil-water management can minimize irrigation needs. This program can also improve the hydrologic characteristics of each project area and solve the other needs enumerated. Further, a pollution abatement program will improve water quality for all uses including irrigation.

New programs must be developed to increase the amount of private land available for hunting and fishing.

## LOCAL INTEREST IN PROJECT DEVELOPMENT

Vegetable growers in the North Collins-Brant area have been interested in the development of an adequate supply of irrigation water for many years. At one time, they requested Cornell University to make a study of potential irrigation reservoir sites. Several sites were recommended, but the full cost of development was to be borne by the growers. This proved to be so much of a burden that growers began developing their own sources of supply.

At present, some growers near Brant in the Delaware-Muddy Creek project area have an ininterest in an irrigation project development. Several indicated they would be interested in more water at a cheaper cost than their present sources.

No local interest in a project development for flood prevention, recreation, fish and wildlife, low flow augmentation or municipal and industrial water supply has been expressed.

Each soil and water conservation district has been assisting landowners with their soil and water management problems under their normal district

program. This includes the planning and development of irrigation systems and sources of irrigation water. Further, both the Erie and Wyoming Districts have maintained the streambank work done by the Soil Conservation Service on Cayuga Creek under the Buffalo Creek project.

Soil and water conservation districts can legally sponsor or co-sponsor PL-566 watershed projects. At this time, no PL-566 application has been filed or considered. Thatcher Brook, Upper Cattaraugus, and Elton Creeks project areas are in the Seneca Trail Resource Conservation and Development Project, but so far no consideration has been given to incorporate the proposal for these areas in the RC&D plan.

The State of New York, through the Division of Water Resources of the Department of Environmental Conservation, and the Erie-Niagara Basin Regional Water Resources Planning Board, are keenly interested in the development of water for agricultural and other uses, as a part of their comprehensive plan for the full development of the water resources of the Basin.

## RECOMMENDED WORKS OF IMPROVEMENT AND ALTERNATIVES FOR POTENTIAL DEVELOPMENT

### Land Treatment

Soil and water conservation districts continuing program of assistance to landowners in land use planning and land treatment for erosion control, drainage, and soil-water management in accordance with landowner goals will have to be accelerated before a more intensive irrigation program can be instituted.

To realize full benefits from irrigated lands, a high level of management in agronomic, cultural, and land treatment measures will need to be implemented. Some of the land treatment measures include contour farming, crop residue management, diversions, drains (tile), drainage mains and laterals, drainage land grading, grassed waterway or outlets, mulching, stripcropping, and terraces. These same practices will also benefit non-irrigated cropland. Water from the distribution systems may be held in storage ponds for later irrigation use.

On grassland, practices such as pasture and hayland planting and renovation, rotation grazing, ponds, and fencing livestock are suggested. On forest land, needed treatment measures include protection against fire and domestic livestock, proper location and maintenance of logging roads and skid trails and hydrologic stand improvement practices to establish and maintain desirable species stocking and stand conditions. Recreational use of forest land will require an adjustment in the management and treatment measures needed to protect these areas.

Wildlife habitat development can be accomplished by tree, shrub and food plantings, mowing, windbreaks, cut-back borders, ponds and marshes. Fencing to exclude livestock and vegetative plantings on proper sloped streambanks will benefit trout fisheries.

To protect and improve environmental quality in suburban developing areas, land treatment measures include the optimum use of natural vegetation, vegetative plantings, grassed waterways, diversions, drainage mains and laterals, mulching, and debris basins.

A coordinated program of technical assistance by the Soil Conservation Service, Forest Service, Cooperative Extension Service, Agricultural Stabilization and Conservation Service, Farmers Home Administration, and the New York State Department of Environmental Conservation, will best meet the objectives of the project area farmers and other landowners.

Additional assistance from the Federal Land Bank, the Production Credit Association and other local agencies will also be helpful. Technical assistance is available to local communities to help them in land use planning and zoning, and the development of planned facilities for each project area. Such assistance is needed to retain an optimum amount of vegetative cover on all areas being planned.

Further, technical assistance can be provided to developers for on-site plans to minimize the deterioration of the natural environment during development. This assistance will also benefit fish and wildlife habitat and enhance the aesthetic quality and well-being of the community.

#### Structural Measures

A total of 19 upstream reservoir sites costing an estimated \$7,505,000 are recommended for development to serve the adjacent, nearly 6,400 acres of irrigable land. The design of the 13 sites primarily for irrigation is to provide 12 inches of irrigation water storage for each of the 6,400 acres of cropland.

Five of these sites contain 7,600 acre-feet of storage for low flow augmentation and one site provides flood control. Besides these 13 irrigation sites, there are 6 additional sites which could provide 530 surface acres of water for recreation and/or fish and wildlife use.

In any future planning on Clear, Upper Cattaraugus, and Elton Creeks, alternatives which will preserve trout habitat should be weighed against other purposes. Such works as stream improvement and maintenance to provide pools and riffles, and bank stabilization should be implemented.

The attached project plan maps show the location of the recommended reservoir sites and Tables 1 through 6 list details pertaining to the design, cost and benefits of each site.

Description of these reservoir sites and the possible alternatives are discussed by project area in the following paragraphs:

Project 1-B - Little Buffalo-Cayuga Creeks - Three reservoir sites in this project area are recommended for development. Two are irrigation sites and one is for recreation and/or fish and wildlife.

Sites 1-6 and 1-7 would supply irrigation water for about 700 acres of cropland. Site 1-11 can be developed for a 20-acre recreation and/or fish and wildlife lake. The total estimated installation cost for these three sites is \$433,700.

Other potential recreation and/or fish and wildlife sites considered as alternatives were 1-2, 1-3, 1-5, 1-12, and 1-15. All have higher installation costs than site 1-11.

Sites 1-6 and 1-7, selected for irrigation use, also have potential for recreation and/or fish and wildlife use.

Project 44-A - Clear Creek - Three sites, 44-1, 44-7, and 44-64, are suggested to provide irrigation water for approximately 2,290 acres. Three downstream pump systems will be needed to distribute the irrigation water provided by site 44-64. One other site, 44-4, is recommended for a 50-acre recreation or fish and wildlife lake. These sites, including the pump system, are estimated to cost \$1,634,700.

Site 44-64 would also provide 4,000 acre-feet for low flow augmentation for the lower 5 miles of Cattaraugus Creek. On the other hand, this 4,000 acre-feet could be allocated to municipal and industrial water for the village of Gowanda, if needed. This site is also being considered as a trout lake.

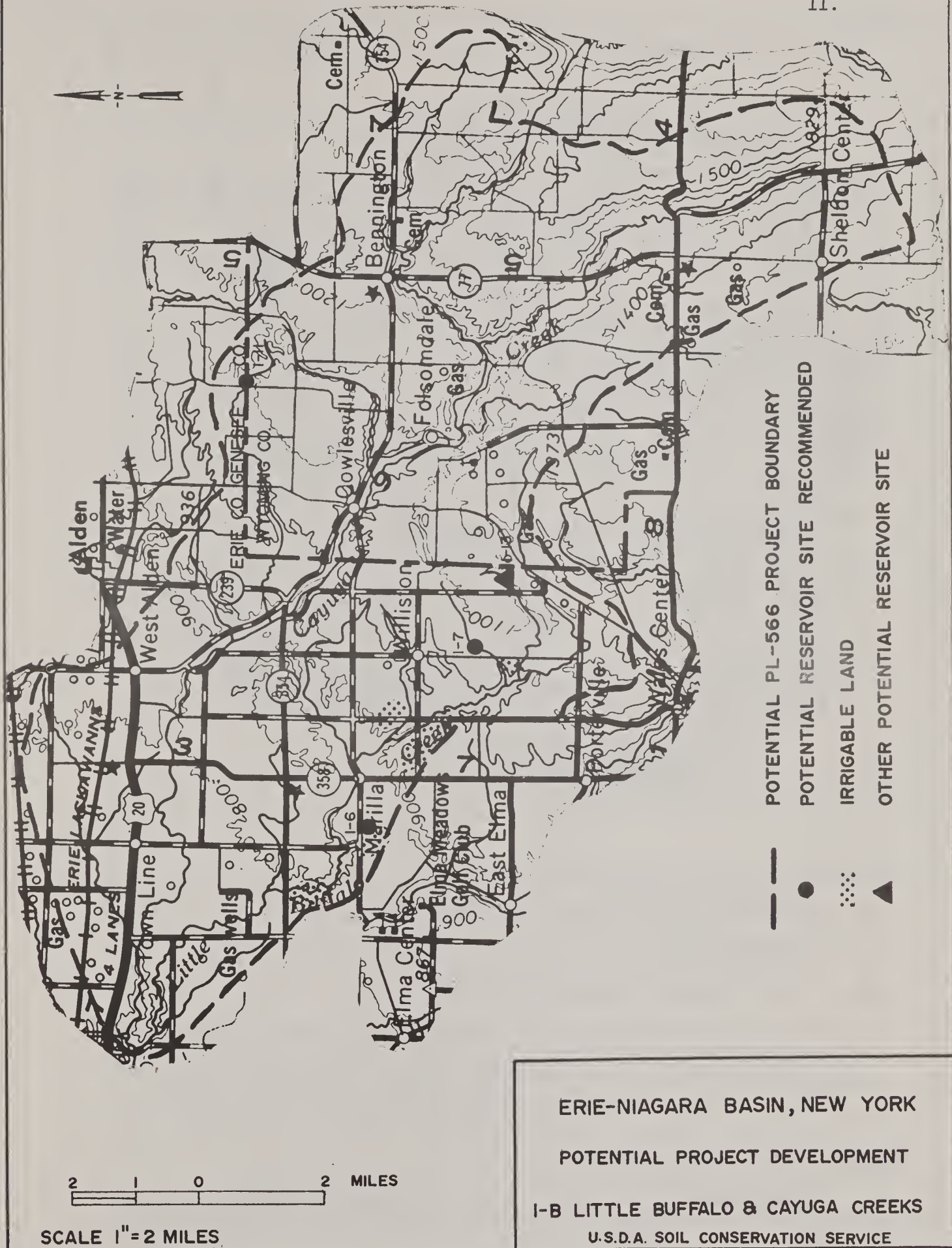
There is a possibility that ground water is available in sufficient quantity to be a more feasible solution for irrigation needs in the areas serviced by sites 44-1 and 44-64. This should be more thoroughly investigated in future studies.

Other alternatives evaluated were various reservoir site combinations. Site 44-32 and 44-33 are considered as alternate possibilities for site 44-1. Site 44-1 was chosen because of a more favorable benefit-cost ratio. Site 44-65 was considered an alternate for site 44-64, but was not chosen since it lacks the amount of beneficial storage needed. If storage needs were reduced to the approximately 880 acre-feet available in site 44-65, both sites would be comparable in total cost.

Sites 44-1, 44-5, 44-7, 44-33, and 44-65 were also considered as possible recreation sites. Sites 44-1 and 44-7 were considered to be more beneficial for single purpose irrigation. Individually, 44-5, 44-33, and 44-65 not only are more expensive than site 44-4, but each also has a smaller beneficial pool area for recreational use.

Project 44-B - Thatcher Brook - Purposes in this project area are to provide irrigation water, develop a recreation and/or fish and wildlife facility, and to reduce flood damages in the village of Gowanda.

Only two reservoir sites were identified. Site 44-34 would provide about 300 acre-feet of water for irrigation. It would also store runoff from approximately 30 percent of the Thatcher Brook drainage area which contributes to the flooding in Gowanda. Site 44-3 would be developed for a 100-



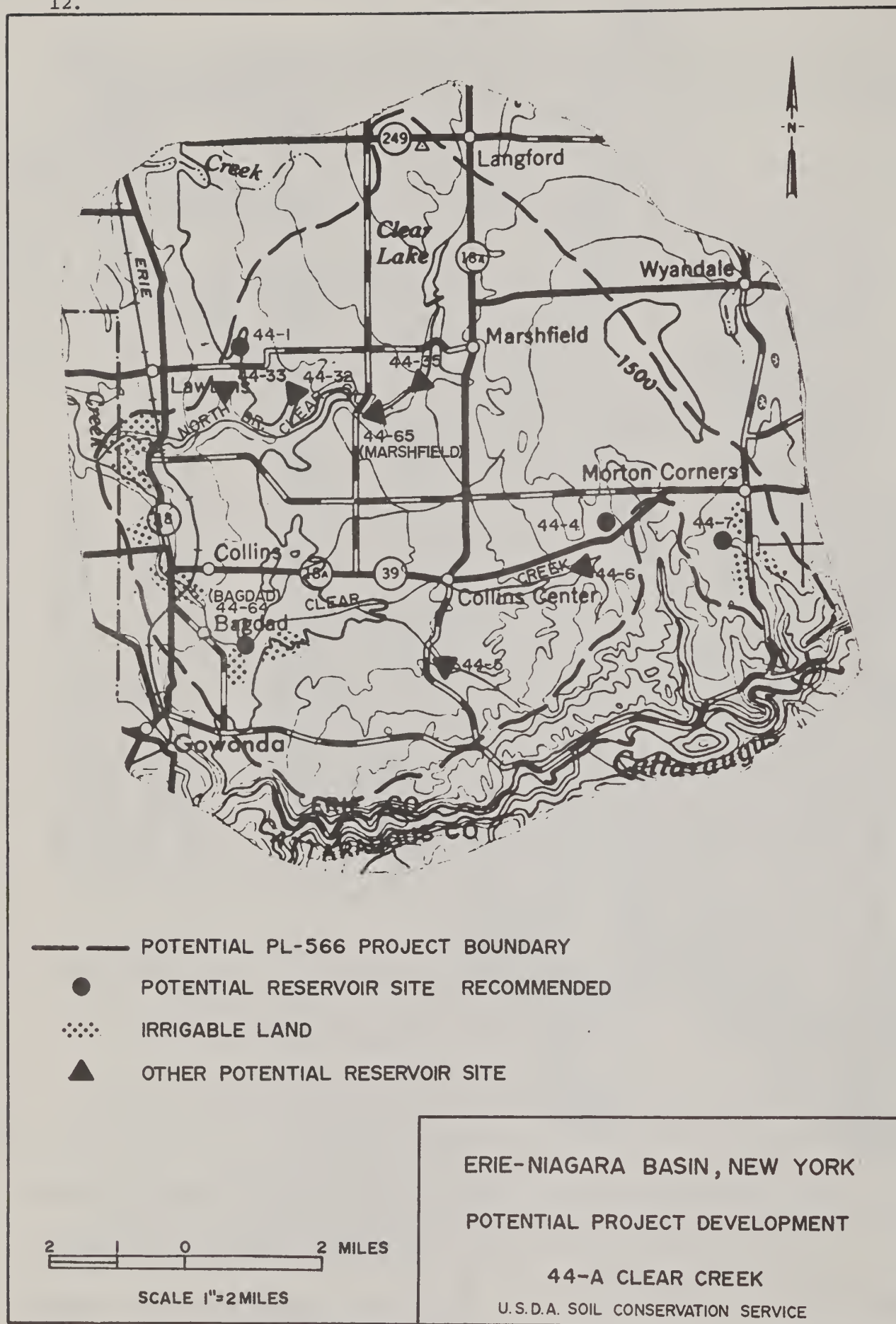


FIGURE 4

acre recreation and/or fish and wildlife lake. Estimated cost of these two sites is \$1,469,300.

Both sites are possible supplies of municipal and industrial water to the village of Gowanda, if the need should arise in the future.

Project 44-C - Upper Cattaraugus Creek - Five sites were selected in the Upper Cattaraugus Creek project area. Four sites, 44-22, 44-23, 44-56, and 44-59 would provide about 1,550 acre-feet of irrigation water. An additional 2,900 acre-feet of water for low flow augmentation to Clear Creek (Cattaraugus County) for pollution abatement at Sandusky and Arcade would also be supplied by 44-22, 44-23, and 44-59.

Full utilization of 44-22 requires the installation of a pump delivery system. With 100 surface acres, site 44-28 would be developed for recreation and/or fish and wildlife. Total installation cost for these five sites is estimated to be \$2,045,000.

Preliminary information indicates that ground water may be a more feasible irrigation water supply than the recommended reservoir sites. A thorough study should be made of the quantity and quality of ground water and the cost of developing this source.

Considered as alternatives for site 44-56 were sites 44-28 and 44-29. Site 44-29 was not chosen because its 0.4 square mile drainage area limits the amount of irrigation water that would be available. Site 44-28 was better suited for recreation development.

Sites 44-29, 44-60, 44-61, and 44-63 were also studied for recreation potential. Site 44-28 was recommended because it has a more favorable beneficial pool area than 44-29 and 44-60 and is not as costly as 44-61. Site 44-63 is a possible multipurpose site if future studies demonstrate the need for a large impoundment.

Project 44-D - Elton Creek - This project consists of two reservoir sites. Site 44-27 would provide about 300 acre-feet of irrigation water and 44-54 would be developed for a 90-acre recreation and/or fish and wildlife lake. Cost of this project is estimated at \$705,400.

A preliminary study indicates that there is the possibility that ground water is available in sufficient quantity to provide irrigation water for that area supplied by site 44-27. A more detailed study would have to be made before this ground water possibility is considered as a definite replacement. Site 44-55 was considered as a replacement for site 44-27, but was found to be less economical.

Project 72-A - Delaware-Muddy Creeks - This project area has two recommended sites, 72-8 and 72-9. Site 72-8 is designed to provide about 800 acre-feet of beneficial storage for irrigation. Site 72-9 would provide approximately 170 surface acres for recreation and/or fish and wildlife. Total cost of these impoundments is estimated at \$923,000.

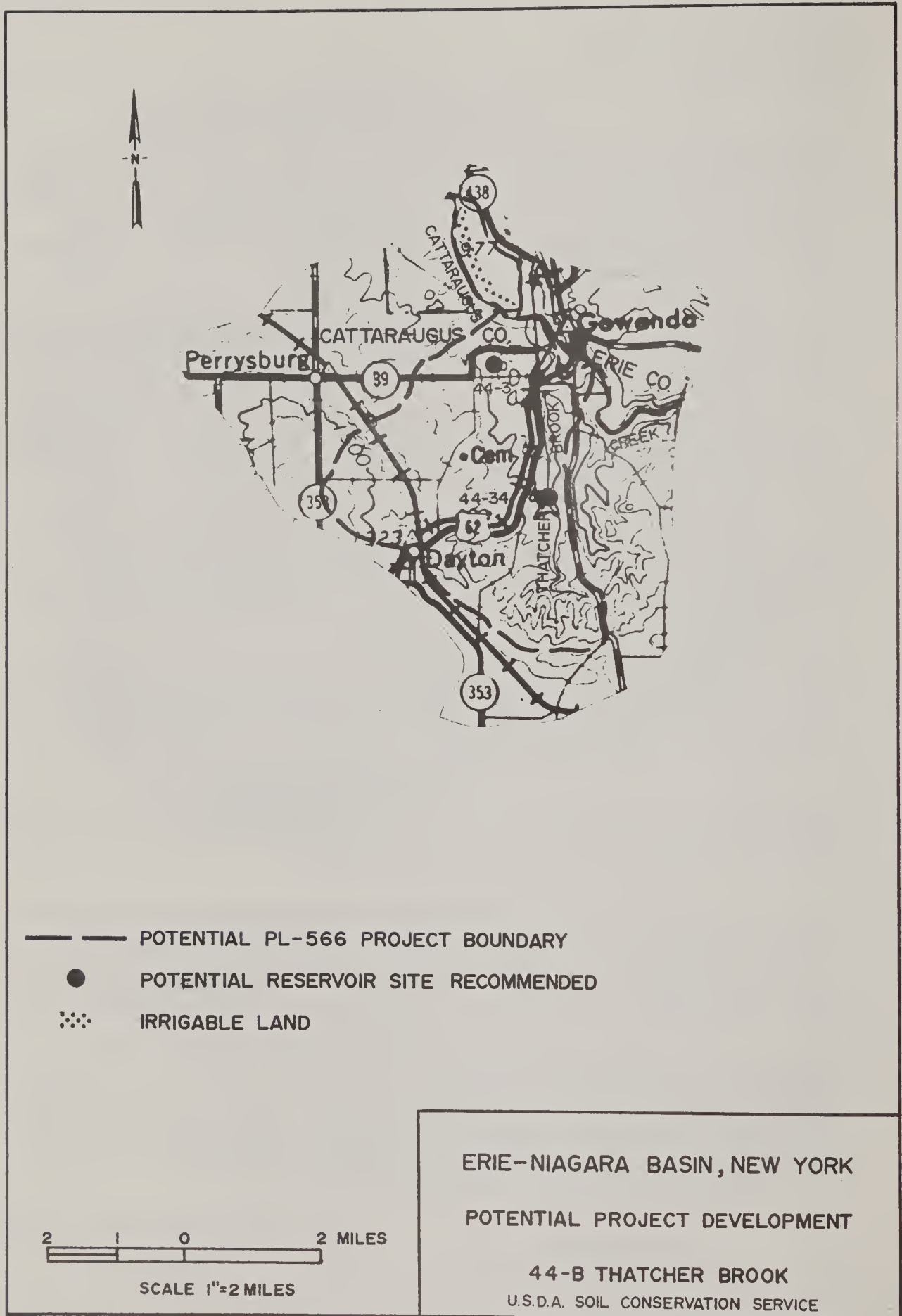


FIGURE 5

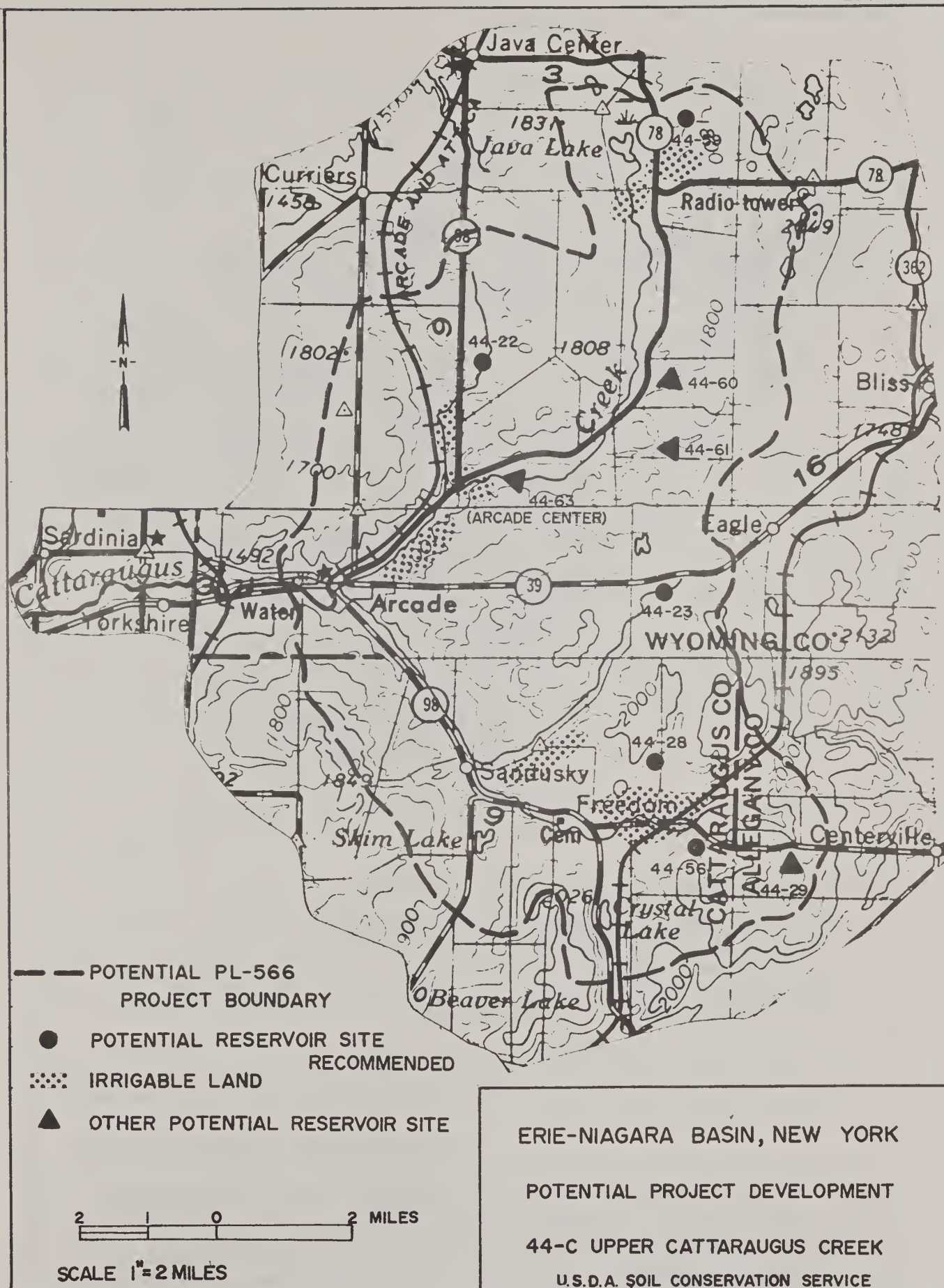


FIGURE 6

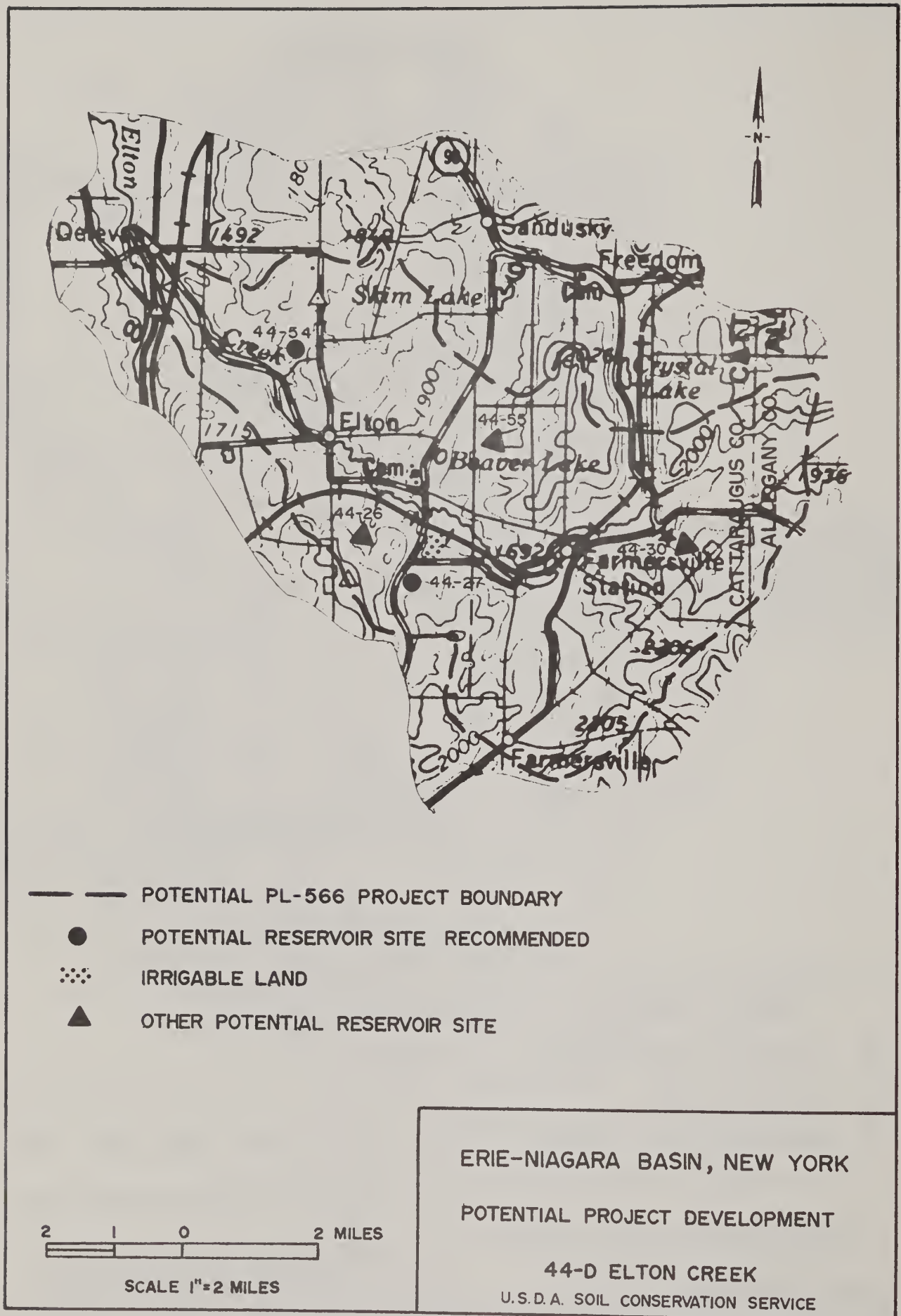


FIGURE 7

Site 72-9 is in an excellent location to provide municipal and industrial water to the hamlet of Farnham. However, it should be recognized that this site could not support both a 170-acre recreation and/or fish and wildlife lake and a municipal water supply because of a limited watershed yield. A smaller sized recreation lake would result if both purposes were implemented.

An alternative that should be explored further is the possibility of providing irrigation needs from a ground water source instead of site 72-8. Preliminary studies indicate that ground water may be available in sufficient quantities for irrigation.

Other sites considered for recreation were 72-7 and 72-8. Site 72-8 was recommended for irrigation and 72-7, although cheaper than 72-9, is limited in pool size because of topography.

Project 238-A - North Pembroke - Only one site, 238-2, is included in this project area. This site would provide about 500 acre-feet of irrigation water and cost an estimated \$293,700.

Because of the lack of potential reservoir sites and ground water sources in this area, no alternates were considered.

#### NATURE AND ESTIMATE OF COST OF IMPROVEMENTS

Before irrigability of land could be determined, several criteria and assumptions were defined. They were: irrigation water would be applied through a sprinkler system, irrigable lands would be restricted to 0.5 percent slopes, soils are well drained or capable of being adequately drained for intensive cropping, and permeability of the soil to a depth of 24 inches is at least 0.2 inches per hour.

Using these assumptions and data from soil survey field sheets, irrigable lands in the Erie-Niagara Basin were delineated on 7 1/2 minute topographic quadrangles.

In the irrigation project areas, criteria for determining the irrigable lands capable of being irrigated from each site were the irrigable lands one-half mile adjacent to the streams and within 5 miles downstream. Potential reservoir structures were identified from a map study of 7 1/2 minute topographic quadrangles. From these maps, drainage areas, available storage and surface areas were determined.

Field surveys of centerlines were made on a few selected sites. For sites having centerline surveys, fill volumes were computed from the survey data, otherwise for all other sites fill volumes were determined from the above-mentioned map data.

All impoundment designs were based on Soil Conservation Service criteria for Public Law 566 structures. Factors considered in the design of these impoundments were: (1) storage needed to retain a 100-year frequency storm without discharge through the emergency spillway, (2) beneficial storage of 12 inches of water for each acre capable of being irri-



- — — — — POTENTIAL PL-566 PROJECT BOUNDARY
- POTENTIAL RESERVOIR SITE RECOMMENDED
- ⋯⋯⋯ IRRIGABLE LAND
- ▲ OTHER POTENTIAL RESERVOIR SITE

2 1 0 2 MILES

SCALE 1"=2 MILES

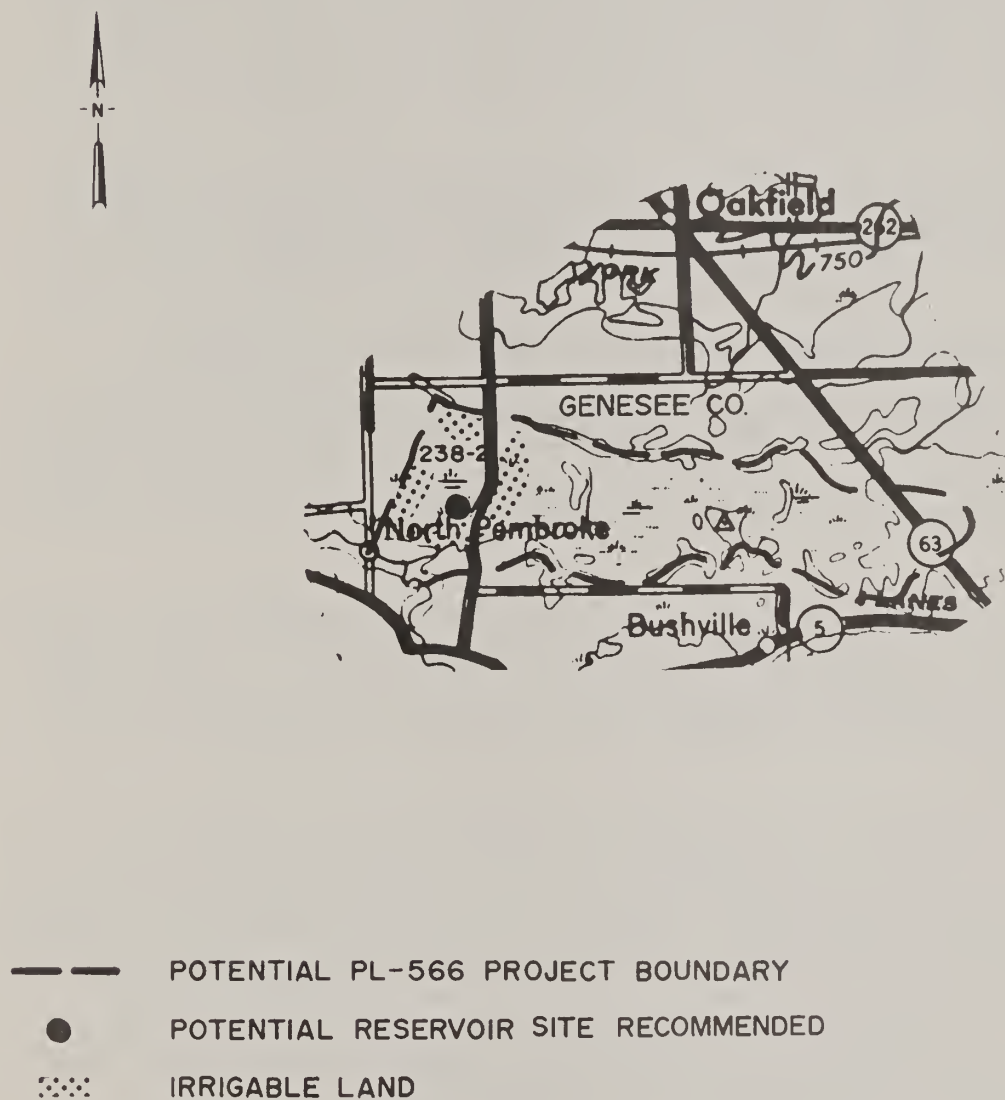
ERIE-NIAGARA BASIN, NEW YORK

POTENTIAL PROJECT DEVELOPMENT

72-A DELAWARE & MUDDY CREEKS

U.S.D.A. SOIL CONSERVATION SERVICE

FIGURE 8



ERIE-NIAGARA BASIN, NEW YORK

POTENTIAL PROJECT DEVELOPMENT

238-A NORTH PEMBROKE

U.S.D.A. SOIL CONSERVATION SERVICE

FIGURE 9

gated, (3) estimated sediment accumulation at 0.5 watershed inches of storage for a 100-year period, (4) limiting topographic and/or geologic conditions, (5) yield of 11 inches or 55 percent of the average annual runoff from the drainage area above the site, (6) allowable release rates and (7) critical land rights elevations.

Construction costs were estimated for all reservoirs using a unit price per cubic yard of compacted fill. This unit price represents all normal construction items and is based on a comparative study of actual contract costs of Public Law 566 structures in New York. Where unfavorable geologic conditions exist, the additional cost of treating the condition was estimated. Pump systems are needed to distribute water from two sites, and the estimated costs of these systems were included in the cost of each site.

Total installation cost includes the construction cost and land rights plus 20 percent for contingencies, 27 percent for installation services and 2 percent for administration of contracts. An estimated cost of basic facilities has been included for the recommended recreation sites.

#### EFFECTS AND ECONOMIC FEASIBILITY OF POTENTIAL DEVELOPMENT

Along with providing water for irrigation, the proposals will provide for floodwater control, low flow augmentation, and recreation and/or fish and wildlife development. Table 4 shows the average annual costs, and Table 5 lists the average annual benefits and benefit-cost ratio for each project area and reservoir site.

An adequate supply of water will be available for irrigating 6,400 of the 27,000 acres of irrigable land in the seven project areas. Annual benefits assigned to irrigation are expected to be \$193,250. All associated cost for installing land treatment practices which are essential for the realization of irrigation benefits were estimated and deducted from the gross benefits.

The on-farm distribution system for irrigation water was included in this cost. For the individual grower, there will be an increase in net return due to increased crop yields of better quality, reduced production costs and more efficient operations. Moreover, he can use irrigation to control late spring frosts thus giving him a wider choice of crops and varieties to meet market demands. Several areas will need to change farming operations to more intensive cropping systems to make irrigation profitable. Overall effects will be increased stability of individual farms and a more viable agribusiness in the communities.

Average annual floodwater damage on Thatcher Brook is \$4,420. Under the proposals recommended for this project area, preliminary estimates indicate a \$2,250 average annual reduction in damages. More detailed studies are needed if the project is to be installed.

For the five reservoir sites in project areas 44-A, 44-B, and 44-C, average annual benefits assigned to low flow augmentation are estimated to be

\$70,950. Benefits were assumed to equal costs as representing the least costly alternatives. These benefits will accrue from pollution abatement in the Arcade-Sandusky area and the lower five miles of Cattaraugus Creek.

As a supplement to the park and recreation facilities in the Erie-Niagara Basin, six additional single purpose recreation and/or fish and wildlife sites are proposed. There is one site in each of the project areas except North Pembroke (238-A). Those sites are well distributed through the south central part of the basin. Average annual benefits are estimated to be \$576,000 based on a value of \$1.50 per visitor day.

The use of a reservoir site for recreation activities such as camping, picnicking, swimming, or nature study is not generally compatible with irrigation or low flow augmentation. A "put and take" trout lake fishery would not be affected like other recreation activities as draw-down would not begin significantly until July and August, which is after the heaviest fishing pressure. Boating would be least affected. Recreation and fish and wildlife are compatible with flood control.

Table 6 (Part A) shows the allocation of the total \$7,504,800 cost according to purpose, project area and site. Part B of Table 6 shows the Public Law 566 cost-share will be \$2,786,300 while the local share will be \$4,718,500.



TABLE 2 - RESERVOIR STORAGE CAPACITY

## ERIE-NIAGARA BASIN

Watershed No. Name		Project Area	Site No.	Drainage Area Sq. Mi.	Storage Capacity Planned						Additional Storage Cap. Available 2/ Acre Feet	
					Sediment	Detention	Subtotal 1/ Flood Prev. Acre Feet	Irrigation (Inches Equiv.)	Recreation	Low Flow		Total
1	Buffalo Creek	1-B Little Buffalo & Cayuga Creeks	1-6 1-7 1-11	1.5 0.7 0.4	40(0.5) 20(0.5) 10(0.5)	140(1.8) 100(2.5) 60(2.6)	180(2.3) 120(3.0) 70(3.1)	300(3.8) 400(10.2) -	- - 120(5.2)	- - -	480(6.1) 520(13.2) 190(8.3)	80 40 -
44	Cattaraugus Creek	44-A Clear Creek	44-1 44-4 44-7 44-64	2.3 2.3 0.5 20.0	60(0.5) 60(0.5) 10(0.5) 530(0.5)	300(2.5) 310(2.5) 60(2.3) 2490(2.3)	360(3.0) 370(3.0) 70(2.8) 3020(2.8)	450(3.7) - 240(9.0) 1600(1.5)	- 1060(8.6) - -	- - - 4020(3.8)	810(6.7) 1430(11.6) 310(11.8) 8640(8.1)	880 270 50 -
		44-B Thatcher Brook	44-3 44-34	2.1 2.1	60(0.5) 60(0.5)	270(2.5) 250(2.3)	330(3.0) 310(2.8)	- 300(2.7)	2740(24.5) -	- 740(6.6)	3070(27.5) 1350(12.1)	- 430
		44-C Upper Catta- raugus Creek	44-22 44-23 44-28 44-56 44-59	4.7 2.9 1.7 1.2 1.6	130(0.5) 80(0.5) 50(0.5) 30(0.5) 40(0.5)	620(2.5) 370(2.5) 180(2.1) 160(2.3) 180(2.1)	750(3.0) 450(3.0) 230(2.6) 190(2.8) 220(2.6)	750(3.0) 180(1.2) - 400(6.0) 220(2.6)	- - 2170(24.2) - -	1300(5.2) 1020(6.6) - - 570(6.7)	2800(11.2) 1650(10.8) 2400(26.8) 590(8.8) 1010(11.9)	680 300 - 290 140
		44-D Elton Creek	44-27 44-54	0.8 3.1	20(0.5) 80(0.5)	110(2.3) 410(2.5)	130(2.8) 490(3.0)	300(6.7) -	- 1390(8.4)	- -	430(9.5) 1880(11.4)	170 440
72	Little & Big Sister Creeks	72-A Delaware & Muddy Creeks	72-8 72-9	3.8 2.2	100(0.5) 60(0.5)	510(2.5) 290(2.6)	610(3.0) 350(3.1)	800(4.0) -	- 3100(27.0)	- -	1410(7.0) 3450(30.1)	- -
238	Middle Tona- wanda Creek	238-A North Pembroke	238-2	1.1	30(0.5)	130(2.3)	160(2.8)	500(8.7)	-	-	660(11.5)	-

<sup>1/</sup> Flood prevention storage is primarily needed for the safe design of the structure except for Site 44-34 where it also reduces significant flood damages.

<sup>2/</sup> This additional storage can be provided only by increasing the planned storage capacity with a corresponding increase in cost.

TABLE 3 - DISTRIBUTION OF STRUCTURAL COST-POTENTIAL DEVELOPMENT

ERIE-NIAGARA BASIN  
1/  
(Dollars)

Watershed No.	Project Area	Structural Measures	Installation Cost				Total Installation Cost
			Construction	Installation Services	Land Rights	Administration of Contracts	
1	Buffalo Creek and Cayuga Creeks	Site 1-6 Site 1-7 Site 1-11 Rec. Fac. Site 1-11	96,400 93,800 56,100	26,000 25,300 15,100	10,000 7,000 6,200	1,900 1,900 1,100	134,300 128,000 78,500 92,900 433,700
	1-B Total		246,300	66,400	23,200	4,900	
44	Cattaraugus Creek	Site 44-1 Site 44-4 Rec. Fac. Site 44-4 Site 44-7 Site 44-64 Pump System Site 44-64	145,700 132,400	39,400 35,800	5,000 17,000	2,900 2,600	193,000 187,800 141,900 167,000 753,300 191,700 1,634,700
	44-A Total		726,800	196,300	363,500	14,500	
	44-B Thatcher Brook	Site 44-3 Rec. Fac. Site 44-3 Site 44-34	578,000	156,100	86,000	11,600	831,700 180,600 457,000 1,469,300
	44-B Total		345,600 923,600	93,300 249,400	11,200 97,200	6,900 18,500	
	44-C Upper Cattaraugus Creek	Site 44-22 Pump System Site 44-22 Site 44-23 Site 44-28 Rec. Fac. Site 44-28 Site 44-56 Site 44-59	305,000 85,000 521,600	83,000 23,000 127,400	16,000 72,000 37,100	6,000 2,000 9,400	410,000 44,100 182,000 695,500 180,600 286,700 246,100 2,045,000
	44-C Total		1,297,900	337,700	159,500	25,200	
	44-D Elton Creek	Site 44-27 Site 44-54 Rec. Fac. Site 44-54	156,200 187,400	42,200 50,600	2,900 85,000	3,100 3,800	204,400 326,800 174,200 705,400
	44-D Total		343,600	92,800	87,900	6,900	
72	Little & Big Sister Creeks	Site 72-8 Site 72-9 Rec. Fac. Site 72-9	162,500 265,500	43,900 71,700	67,500 84,000	3,300 5,300	277,200 426,500 219,300 923,000 293,700
238	Middle Tonawanda Creek	72-A Total 238-A North Pembroke	428,000 197,100	115,600 53,200	151,500 39,500	8,600 3,900	
	7 Potential Project Areas	19 Sites	4,163,300	1,111,400	922,300	82,500	7,504,800
	GRAND TOTAL						

1/ Price Base: 1966

TABLE 4 - ANNUAL COST

ERIE-NIAGARA BASIN

(Dollars)<sup>1/</sup>

Watershed		Project Area	Evaluation Unit	Amortization of 2/ Installation Cost	Operation and Maintenance Cost	Total
No.	Name					
1	Buffalo Creek	1-B Little Buffalo and Cayuga Creeks	Site 1-6	6,600	500	7,100
			Site 1-7	6,290	500	6,790
			Site 1-11	8,430	11,300	19,730
		1-B Total	3 Sites	21,320	12,300	33,620
44	Cattaraugus Creek	44-A Clear Creek	Site 44-1	9,490	500	9,990
			Site 44-4	16,210	17,000	33,210
			Site 44-7	8,210	500	8,710
			Site 44-64	46,470	3,400 <sup>3/</sup>	49,870
		44-A Total	4 Sites	80,380	21,400	101,780
		44-B Thatcher Brook	Site 44-3	49,770	21,500	71,270
			Site 44-34	22,470	500	22,970
		44-B Total	2 Sites	72,240	22,000	94,240
		44-C Upper Catta- raugus Creek	Site 44-22	22,330 <sup>3/</sup>	750 <sup>3/</sup>	23,080
			Site 44-23	8,950	500	9,450
			Site 44-28	43,080	21,500	64,580
			Site 44-56	14,100	500	14,600
			Site 44-59	12,100	500	12,600
		44-C Total	5 Sites	100,560	23,750	124,310
		44-D Elton Creek	Site 44-27	10,050	500	10,550
			Site 44-54	24,630	20,800	45,430
		44-D Total	2 Sites	34,680	21,300	55,980
72	Little & Big Sister Creeks	72-A Delaware and Muddy Creeks	Site 72-8	13,630	500	14,130
			Site 72-9	31,750	26,000	57,750
		72-A Total	2 Sites	45,380	26,500	71,880
238	Middle Tona- wanda Creek	238-A North Pembroke	Site 238-2	14,440	500	14,940
		238-A Total	1 Site	14,440	500	14,940
		GRAND TOTAL		369,000	127,750	496,750

<sup>1/</sup> Price Base: Installation 1966, O&M 1966.<sup>2/</sup> Rate: 100 years @ 4 7/8 percent - Recreation.<sup>3/</sup> Includes pumping costs and operator.

TABLE 5 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

## ERIE-NIAGARA BASIN

1/  
(Dollars)

Watershed No.	Project Area	Evaluation Unit	AVERAGE ANNUAL BENEFITS					Average Annual Cost	Benefit Cost Ratio
			Damage Reduction	Irrigation	Low Flow 2/ Augmentation	Recreation	Total		
1	Buffalo Creek	Site 1-6 Site 1-7 Site 1-11	- - -	9,010 12,010 -	- - -	- - 54,000	9,010 12,010 54,000	7,100 6,790 19,730	1.3:1 1.8:1 2.7:1
44	Cattaraugus Creek	3 Sites Site 44-1 Site 44-4 Site 44-7 Site 44-64	- - - -	21,020 13,510 - 7,210 48,050	- - - 28,170	54,000 - 83,000 - -	75,020 13,510 83,000 7,210 76,220	33,620 9,990 33,210 8,710 49,870	2.2:1 1.4:1 2.5:1 0.8:1 1.5:1
	44-A Total	4 Sites	-	68,770	28,170	83,000	179,940	101,780	1.8:1
	44-B Thatcher Brook	Site 44-3 Site 44-34	- 2,250	- 9,010	- 12,640	105,000 -	105,000 23,900	71,270 22,970	1.5:1 1.0:1
	44-B Total	2 Sites	2,250	9,010	12,640	105,000	128,900	94,240	1.4:1
	44-C Upper Cattaraugus Creek	Site 44-22 Site 44-23 Site 44-28 Site 44-56 Site 44-59	- - - - -	22,520 5,260 - 12,010 6,610	13,020 8,040 - - 9,080	- - 105,000 - -	35,540 13,300 105,000 12,010 15,690	23,080 9,450 64,580 14,600 12,600	1.5:1 1.4:1 1.6:1 0.8:1 1.2:1
	44-C Total	5 Sites	-	46,400	30,140	105,000	181,540	124,310	1.5:1
	44-D Elton Creek	Site 44-27 Site 44-54	- -	9,010 -	- -	- 101,000	9,010 101,000	10,550 45,430	0.9:1 2.2:1
72	Little & Big Sister Creeks	2 Sites Site 72-8 Site 72-9	- - -	9,010 24,020 -	- - -	101,000 - 128,000	110,010 24,020 128,000	55,980 14,130 57,750	2.0:1 1.7:1 2.2:1
238	Middle Tonawanda Creek	2 Sites Site 238-2	- -	24,020 15,020	- -	128,000 -	152,020 15,020	71,880 14,940	2.1:1 1.0:1
	238-A Total	1 Site	-	15,020	-	-	15,020	14,940	1.0:1
	GRAND TOTAL		2,250	193,250	70,950	576,000	842,450	496,750	1.7:1

1/ Price Base: 1966.

2/ Benefits allocated to Low Flow Augmentation are assumed equal to the cost for that use.

TABLE 6 (PART A) - COST ALLOCATION AND COST SHARING SUMMARY

ERIE-NIAGARA BASIN  
1/  
(Dollars)

COST ALLOCATION								
PURPOSE								
Watershed No.   Name	Project Area	Item	Flood Prevention		Low Flow Augmentation		2/ Recreation	Total
				Irrigation				
1 Buffalo Creek	1-B Little Buffalo & Cayuga Creeks	Site 1-6	-	134,300	-	-	-	134,300
		Site 1-7	-	128,000	-	-	-	128,000
		Site 1-11	-	-	-	-	171,400	171,400
		3 Sites	-	262,300	-	-	171,400	433,700
		44-A Clear Creek	-	193,000	-	-	-	193,000
44 Cattaraugus Creek	44-A Clear Creek	Site 44-1	-	-	-	-	329,700	329,700
		Site 44-4	-	167,000	-	-	-	167,000
		Site 44-7	-	402,600 3/	542,400	-	-	945,000
		Site 44-64	-	-	-	-	-	-
		44-A Total	-	762,600	542,400	329,700	1,634,700	
	44-B Thatcher Brook	Site 44-3	-	-	-	-	1,012,300	1,012,300
		Site 44-34	102,800	102,800	251,400	-	457,000	
		2 Sites	102,800	102,800	251,400	1,012,300	1,469,300	
		Site 44-22	-	195,800 3/	258,300	-	454,100	
		Site 44-23	-	27,300	154,700	-	182,000	
	44-C Upper Cattar- augus Creek	Site 44-28	-	-	-	876,100	876,100	
		Site 44-56	-	286,700	-	-	286,700	
		Site 44-59	-	68,800	177,300	-	246,100	
		5 Sites	-	578,700	590,200	876,100	2,045,000	
		44-C Total	-	204,400	-	-	204,400	
	44-D Elton Creek	Site 44-27	-	-	-	-	501,000	501,000
		Site 44-54	-	-	-	-	-	-
		2 Sites	-	204,400	-	501,000	705,400	
		72-A Delaware and Muddy Creeks	-	277,200	-	-	277,200	
		Site 72-9	-	-	-	645,800	645,800	
72 Little & Big Sister Creeks	72-A Total	2 Sites	-	277,200	-	645,800	923,000	
		238-A North Pembroke	-	293,700	-	-	293,700	
		238-A Total	-	293,700	-	-	293,700	
		7 Potential Project Areas	19 Sites	102,800	2,481,600	1,384,100	3,536,300	7,504,800
		GRAND TOTAL						

1/ Price Base: 1966

2/ Includes Facilities

3/ Includes Pumping System

TABLE 6 (PART B) - COST ALLOCATION AND COST SHARING SUMMARY

ERIE-NIAGARA BASIN  
1/  
(Dollars)

No.	Name	Project Area	Site	COST SHARING									
				PL-566					Other				
				Flood Prev.	Irrigation	Flow	2/ Recreation	Total	Flood Prev.	Irrigation	Flow	2/ Recreation	Total
1	Buffalo Creek	1-B Little Buffalo & Cayuga Creeks	1-6 1-7 1-11	-	61,200	-	-	61,200	-	73,100	-	-	73,100
				-	59,550	-	-	59,550	-	68,450	-	-	68,450
				-	-	-	82,050	82,050	-	-	-	89,350	89,350
44	Cattaraugus Creek	1-B Total	3 Sites	-	120,750	-	82,050	202,800	-	141,550	-	89,350	230,900
		44-A Clear Creek	44-1	-	92,550	-	-	92,550	-	100,450	-	-	100,450
			44-4	-	-	-	155,050	155,050	-	-	-	174,650	174,650
			44-7	-	80,000	-	-	80,000	-	87,000	-	-	87,000
			44-64	-	153,200	3/-	-	153,200	-	249,400	3/-	-	791,800
		44-A Total	4 Sites	-	325,750	-	155,050	480,800	-	436,850	-	174,650	1,153,900
		44-B Thatcher Brook	44-3 44-34	98,800	-	-	457,350	457,350	-	-	-	554,950	554,950
				-	49,400	-	-	49,400	-	53,400	-	-	308,800
		44-B Total	2 Sites	98,800	49,400	-	457,350	605,550	4,000	53,400	251,400	554,950	863,750
		44-C Upper Cattaraugus Creek	44-22 44-23 44-28 44-56 44-59	-	93,850	3/-	-	93,850	-	101,950	3/-	-	360,250
				-	8,100	-	-	8,100	-	19,200	-	-	173,900
				-	-	-	414,800	414,800	-	-	-	461,300	461,300
				-	138,700	-	-	138,700	-	148,000	-	-	148,000
				-	29,800	-	-	29,800	-	39,000	-	-	216,300
		44-C Total	4 Sites	-	270,450	-	414,800	685,250	-	308,150	590,300	461,300	1,359,750
		44-D Elton Creek	44-27 44-54	-	99,200	-	-	99,200	-	105,200	-	-	105,200
				-	-	-	206,100	206,100	-	-	-	294,900	294,900
72	Little & Big Sister Creeks	44-D Total	2 Sites	-	99,200	-	206,100	305,300	-	105,200	-	294,900	400,100
		72-A Delaware & Muddy Creeks	72-8 72-9	-	103,200	-	-	103,200	-	174,000	-	-	174,000
				-	-	-	278,250	278,250	-	-	-	367,550	367,550
238-A	Middle Tonawanda Creek	72-A Total	2 Sites	-	103,200	-	278,250	381,450	-	174,000	-	367,550	541,550
		238-A North Pembroke	238-2	-	125,150	-	-	125,150	-	168,550	-	-	168,550
GRAND TOTAL		7 Potential Project Areas	19 Sites	98,800	1,093,900	-	1,593,600	2,786,300	4,000	1,387,700	1,384,100	1,942,700	4,718,500

1/ Price Base: 1966

2/ Includes Facilities

3/ Includes Pumping System



